Ontario

Minimally Processed Fruit and Vegetables

# Good Manufacturing Practices Guidebook

**The primary objective of every food safety program is to prevent, minimize or control microbial, chemical and physical contamination.**

For information or to obtain copies of this publication, contact the Ontario Ministry of Agriculture, Food and Rural Affairs at 1-888-466-2372 ext. 64395 or (519) 826-4395 or food@omafra.gov.on.ca.

This *Minimally Processed Fruits and Vegetables Good Manufacturing Practices Guidebook* provides guidelines for a number of food safety practices. While the information provided herein is believed to be accurate, it is not intended to be an all-inclusive description of food safety practices for the production of minimally processed fruits and vegetables. The Ontario Ministry of Agriculture, Food and Rural Affairs does not make any warranty or guarantee, nor does it assume any liability for any production loss, health, safety or environmental hazard caused by use of information contained herein. This guidebook is neither an endorsement of specific food safety practices, companies or products nor a suggestion that other practices, companies or products are unacceptable.

*Cover photographs by Barr Photography*

Published by the Ministry of Agriculture, Food and Rural Affairs
© Queen's Printer for Ontario, 2006
Toronto, Canada

ISBN 1-4249-0344-0 (Print)
ISBN 1-4249-0345-9 (HTML)
ISBN 1-4249-0346-7 (PDF)

02-06-0.5M

2007-04585/

PREFACE

2 BACKGROUND

3 ENVIRONMENTAL CONTROLS

4 OPERATIONAL CONTROLS

5 CONTROL PROGRAMS

6 TRAINING

7 SELF-ASSESSMENT

8 GLOSSARY/
OMAFRA CONTACT INFORMATION

# TABLE OF CONTENTS

## 1 Preface

What Are Good Manufacturing Practices (GMP)s? .................... 1-1
What is the Difference between GMPs and Prerequisite Programs? ....... 1-1
Why Apply GMPs? .................... 1-1
Why Create a Guidebook? .................... 1-2
How to Use This Guidebook .................... 1-2

## 2 Background

Food Safety is Everyone's Business .................... 2-1
Types of Contamination .................... 2-1
Extent of Foodborne Illness - Canada .................... 2-2
Extent of Foodborne Illness - United States .................... 2-3
Reducing Risk .................... 2-4
Implementation Rationale .................... 2-4
Food Safety Programs .................... 2-5
Food Safety Program Accreditation .................... 2-7
The Economics .................... 2-8

## 3 Environmental Controls

**E1 Establishment Location and Construction**

E1.1 Property and Surroundings .................... 3-1
E1.2 Building Exterior .................... 3-3

**E2 Establishment Design**

E2.1 Cross-contamination Control .................... 3-5
E2.2 Personnel Facilities .................... 3-8

**E3 Establishment Interior**

E3.1 Internal Structures and Fittings .................... 3-11
E3.2 Lighting .................... 3-15
E3.3 Lighting Fixtures .................... 3-16
E3.4 Air Quality and Ventilation .................... 3-16
E3.5 Drainage and Sewage Systems .................... 3-17

**E4 Equipment**

E4.1 Equipment Design, Construction and Installation .................... 3-19
E4.2 Waste Containers and Utensils .................... 3-24
E4.3 Hand-washing Stations .................... 3-25

**E5 Water Supply**

E5.1 Adequate Supply and Protection of Water, Ice and Steam .................... 3-27

# Operational Controls

## O1 Personnel Practices

O1.1 Personal Hygiene/Practices .......... 4-1
O1.2 Handwashing .......... 4-2
O1.3 Clothing/Footwear/Headwear .......... 4-8
O1.4 Storage - Clothing/Utensils/Equipment .......... 4-11
O1.5 Injuries and Wounds .......... 4-11
O1.6 Evidence of Illness .......... 4-12
O1.7 Access and Traffic Patterns .......... 4-14
O1.8 Chemical Use .......... 4-17
O1.9 Chemicals Used During Operations .......... 4-18

## O2 Shipping, Receiving, Handling and Storage

O2.1 Conveyance Vehicles .......... 4-20
O2.2 Loading and Unloading Practices .......... 4-21
O2.3 Received Products .......... 4-22
O2.4 Shipping Conditions .......... 4-25
O2.5 Returned and Defective Food Products .......... 4-26
O2.6 Allergen Control .......... 4-27
O2.7 Packaging .......... 4-29
O2.8 Storage Practices .......... 4-31
O2.9 Chemical Storage .......... 4-33
O2.10 Waste Management .......... 4-33

## O3 Sanitation

O3.1 Cleaning and Sanitation .......... 4-36
O3.2 Pre-operational Assessment .......... 4-57

## O4 Equipment Maintenance

O4.1 Preventative Maintenance and Calibration Monitoring .......... 4-59

## O5 Pest Control

O5.1 Pest Control Monitoring .......... 4-62

## O6 Recall

O6.1 Product Code/Labelling Monitoring .......... 4-68
O6.2 Mock Recalls .......... 5-71

## O7 Water Safety

O7.1 Water Treatment Monitoring .......... 4-72
O7.2 Water Safety Monitoring .......... 4-84

## 5 Control Programs

What is Required? ........ 5-1
Operational Controls ........ 5-1
Environmental Controls ........ 5-2
Standard Operating Procedures (SOPs) ........ 5-2
SOP Example ........ 5-3
Sanitation Standard Operating Procedures (SSOPs) ........ 5-5
SSOP Example ........ 5-6
Master Sanitation Schedule ........ 5-7

## 6 Training

Employee Training ........ 6-1
Training Delivery ........ 6-2
Records ........ 6-3

## 7 Self-Assessment

Environmental Assessment ........ 7-1
Operational Assessment ........ 7-7
Control Program Assessment ........ 7-20

## 8 Glossary/OMAFRA Contact Information

Glossary ........ 8-1
OMAFRA Contacts ........ 8-9

## What Are Good Manufacturing Practices (GMPs)?

Good Manufacturing Practices (GMPs) (or Prerequisite Programs) are common-sense practices for creating the conditions required to prevent, minimize or control microbial, chemical and physical contamination in a food production environment.

There are four basic elements in a GMP food safety program. Each is based on the principle of risk reduction through prevention. They include:

- Control Programs—written operational and training policies and descriptions of the resulting operational and training procedures, which are applied during Training and through Operational Controls
- Training—the training procedures
- Operational Controls—the operational procedures in the food production facility
- Environmental Controls—creation of a physical environment favourable for the production of safe food.

## What is the Difference between GMPs and Prerequisite Programs?

The terms "Good Manufacturing Practices" and "Prerequisite Programs" are interchangeable. The term "Good Manufacturing Practices" is used throughout this guidebook.

## Why Apply GMPs?

Food safety is not an option; it's an obligation. The market demands it. Those who fail to provide safe food risk loss of market share, loss of reputation and potential liability costs. Proof of compliance with food safety programs is increasingly becoming a condition of purchase by retailers.

Facing societal costs such as additional health care costs and lost productivity resulting from foodborne illnesses, governments are becoming less tolerant of processors that sell contaminated food. In some jurisdictions (e.g., the United States), GMPs are a regulatory requirement.

Since their creation for NASA in the early 1960s, GMPs have proven to be an effective method of reducing food safety risks in processing facilities all over the world.

## Why Create a GMP Guidebook?

GMP material exists in many different formats and in many different places. Often, descriptions of expectations are vague (e.g., "adequate," "proper") and there are few specifics as to how to achieve "adequate" or "proper." This fragmentation makes it difficult and time consuming for processors to gather all the information necessary to begin a GMP in their facility.

By consolidating food safety explanations, suggestions and options into one document, OMAFRA provides a single reference for fruit and vegetable processors that wish to initiate a food safety program.

## How to Use This GMP Guidebook

Each chapter in this guidebook is designed to stand alone. The advantage of this format is that a reader can choose any section of the guidebook and access a full discussion of the selected topic. The disadvantage to this approach is that it creates repetition between sections.

The guidebook is divided into seven sections:

- Preface
- Background
- Environmental Controls
- Operational Controls
- Written Programs
- Training
- Self-Assessment.

The Environmental Controls and Operational Controls sections follow the format and numbering used by OMAFRA's GMP Advantage program manual. **Each heading in these sections begins with the *GMP Advantage* standard in bold print.** Rather than repeat the identical standard for each required individual written and training program, **the written program standard and the training program standard are presented in bold print only once at the beginning of their respective sections.** The remainder of each section provides suggestions and options as to how to achieve the standard required by *GMP Advantage*.

The **Background** section discusses the types of contamination commonly found in minimally processed foods of plant origin and the extent of foodborne illnesses. The rationale for implementation of a food safety program follows, with a description of the components of a full-fledged food safety program completing the section.

Physical conditions required in a production facility are outlined in the **Environmental Controls** section. With risk reduction in mind, it begins with the establishment location, describes criteria for facility design and construction, outlines interior facility requirements, discusses equipment design construction and installation, and concludes with a detailed discussion of the many different aspects of water safety.

Each section first describes the expected outcome. Then it outlines generally accepted standards and offers options to reach those criteria. For example, Section E4.1 notes, "Equipment should be designed, constructed and installed so that it performs its intended function; is accessible for cleaning, sanitizing, maintenance and inspection; and minimizes the potential for biological, chemical and physical contamination during operations." To achieve this expected result, the manual goes on to give specific suggestions regarding food contact surfaces, equipment construction and equipment installation.

All processing operations must be conducted in a way that will protect the product from contamination. **Operational Controls** explains the operational conditions that encourage the production of safe food. The standards for food handler hygiene, sanitation, chemical use, equipment maintenance, pest control, water safety, shipping, receiving, storage, and recall are outlined. For example, Sections O1.1 to O1.6 describe hygiene standards including personal practices, hand washing, clothing/footwear/headwear, clothing/equipment/utensil storage, injuries and wounds, and evidence of illness.

To ensure consistent implementation of food safety practices, policies and procedures (Standard Operating Procedure [SOPs] and Sanitation Standard Operating Procedures [SSOPs]) must be developed and documented. This documentation is addressed in the **Control Programs** section. To ensure that procedures are executed properly, workers must be trained, which is discussed in the **Training Section**.

To help identify GMP compliance in a facility, the guidebook concludes with a generic **Self-Assessment** section where an operation can be evaluated against generally accepted standards/requirements. This self-assessment begins with a series of statements outlining the accepted standard for each operational and physical area of a facility. Give each area a 1 to 5 rating against that standard. At the conclusion of each section, total the points and calculate a percentage. These scores will help identify risk areas, provide direction for corrective action, and point out documentation and training needs.

Obviously, not every situation encountered by individual food processors can be addressed in this manual; nor will every procedure suggested apply to every processor. However, by using a combination of procedures outlined in this manual and judgment appropriate to the circumstance, processors can create conditions favourable for the production of safe food.

For some, implementation of GMPs may be an easy step; possibly as little as documenting the good practices already being followed. For others, considerable financial and managerial resources may be required. For example, alterations to the physical facilities may be required, sanitation practices may need to be overhauled or employee SSOP training may be necessary.

We encourage you to review the various sections in this manual. While you may not currently think in terms of the headings found in this manual, you may be surprised to discover that much of what you're already doing meets the requirements of an effective food safety program.

Once you become familiar with the environmental and operational criteria, do a self-assessment of your operation. Compare where your operation is with where it should be (a gap analysis). Pick one area (e.g., sanitation) that needs attention. Revise your procedures in that area to meet accepted GMP standards. Train or retrain your employees until they meet those new procedural standards. Monitor and record the results. Then do another self-assessment in that area to measure your progress.

Once you have one operational or environmental area up to accepted GMP standards, address the needs of another area in the same way.
Should you require assistance, OMAFRA has several food safety specialists on staff. They are listed on the inside of the back cover of this guidebook. Do not hesitate to contact them.

# BACKGROUND

**Food Safety Is Everyone's Business**

The eating habits of Canadians have transformed during the past decade. As the health benefits of minimally processed fruits and vegetables have become more widely known and accepted, the variety and quantity consumed have increased dramatically. In addition to familiar, locally grown foods, consumers have access to foods from around the globe.

In response to busy lifestyles, many foods are now prepackaged in a minimally processed, ready-to-eat, value-added form. Regrettably, there has also been a corresponding rise in the number of foodborne illnesses linked to fruits and vegetables even as the overall incidence of foodborne illness appears to be decreasing.

All food producers and processors have an obligation to produce and sell food that is both safe and of high quality. Traditional production practices may no longer be adequate to meet society's increasing food safety and quality expectations. Consumer confidence in the safety and quality of Ontario-grown food and the long-term viability of Ontario's producers will be secure only if everyone in the industry is proactive on food safety and quality issues.

Throughout the food production, processing and distribution continuum, disease-causing, toxic or other harmful hazards may be introduced into the food supply. These hazards may be biological, chemical or physical. Ingestion of food containing any of these hazards may result in illness or injury.

**Types of Contamination**

Bacteria, moulds, parasites and viruses are everywhere in the environment. Some of these microorganisms are beneficial to humans, and many are harmless. However, others, known as pathogens, have the potential to cause foodborne illnesses.

More than 250 known diseases are transmitted through food by biological hazards. In foods of plant origin, these hazards include the pathogenic bacteria *Salmonella* spp., *Escherichia coli* (*E. coli*) O157:H7, *Shigella* spp., *Listeria monocytogenes*, and many others that may result from food contact with soil, water, manure, sewage, animals, air and/or humans. Illness-causing parasites include *Cryposporidium*, *Cyclospora*, *Giardia*, *Entamoeba*, and others. Infected food handlers may introduce viruses such as Hepatitis A, noroviruses and rotaviruses into food. Moulds growing on the ceilings of coolers and production areas can produce chemical mycotoxins, some of which are toxic enough to cause acute or chronic illness if consumed. To further complicate the issue, previously unknown pathogens continue to be discovered by scientists.

Some chemical contaminants occur naturally; some are a result of environmental contamination. Allergens and mycotoxins (e.g., aflatoxin, patulin) occur in nature. All can be hazardous to human health.

Chemical contaminants may also be added during agricultural production or during processing. Added chemicals may come from pesticides, fertilizers, lubricants, cleaners, sanitizers, pest control products and a multitude of other sources. Food additives or processing aids at levels over the prescribed limit are also chemical contaminants. **Ingestion of certain chemicals or combinations of chemicals can cause chronic illness or even death.**

Physical contaminants such as glass, metal and plastic fragments can injure those inadvertently consuming them. These contaminants can enter food during harvest, transport, storage or processing.

## Extent of Foodborne Illness
—Canada

Estimating the extent of foodborne illness is an inexact science. Scientific methodology, statistical analysis, commodity groupings, and a host of other factors usually differ from study to study so an apples-to-apples comparison is often impossible. This should be kept in mind while reviewing any studies, including those that follow.

OMAFRA's Food Safety Science Unit (FSSU) estimates[1] that 41 per cent of foodborne illness in Ontario can be attributed to foods of plant origin. This exceeds every other food group including meat, fish, dairy and eggs. On average, FSSU estimates that foods of plant origin caused 90,200 illnesses annually from 1997 to 2001. The estimated annual health-related cost (health care, lost wages and other economic losses caused by illness) resulting from these foodborne illnesses was $143,591,577, second only to foodborne illness costs associated with meat.

During the same period, studies in the United States estimated produce-related illness outbreaks at 12 per cent of the total food-related outbreak total.

---

[1] with 90 per cent confidence

A report published in the June 2003 *Journal of Food Protection* offers insight into the relationship between intestinal illnesses in Ontario and food contamination. The report, titled *Enteric Illness in Ontario, Canada, from 1997 to 2001,* identifies foodborne contamination as the mode of transportation for 74.0 per cent (14,580) of the outbreaks caused by eight enteric pathogens. Foods of plant origin accounted for 31.6 per cent of the contaminated food investigated in this report.

The *Enteric Illness* report concluded that there appears to be a downward trend in the number of eight enteric diseases studied in the 1997 to 2001 period compared to the previous 1992 to 1996 five-year period. Despite an increase in population, the number of cases from 1997 to 2001 (44,451) was fewer than the number of cases reported from 1992 to 1996 (56,690). No reason for this decline is offered. In all foods, *Campylobacter* was the leading cause of illness in Ontario in both five-year periods, followed by *Salmonella*, VTEC (verotoxin *E. coli*), *Yersinia*, *Shigella*, Hepatitis A, *Listeria*, and *Clostridium botulinum*. There were 113 foodborne-illness-related deaths in Ontario between 1997 and 2001. The report cautions, "Although the incidence of these enteric diseases appears to be declining, the potential remains for occurrences of large outbreaks resulting from a pathogen having contaminated a widely distributed food product or a large water distribution system."

## Extent of Foodborne Illness

—United States

Using statistics derived from the U.S. Centers for Disease Control, the Center for Science in the Public Interest (CSPI) linked 554 illness outbreaks involving 28,315 illnesses to produce between 1990 and 2003. Twenty-four per cent of these produce-related outbreaks were caused by salads, 18 per cent by produce dishes, 16 per cent by vegetables other than those listed below, 10 per cent by fruits other than those listed below, 8 per cent by lettuce, 5 per cent by sprouts, 5 per cent by potatoes, 5 per cent by melons, 3 per cent by mushrooms, 3 per cent by berries, and 3 per cent by home-canned vegetables. Produce accounted for more foodborne illness than seafood, poultry, beef or eggs.

The Foodborne Diseases Active Surveillance Network's report titled *Preliminary FoodNet Data on the Incidence of Infections with Pathogens Transmitted Commonly through Food—Selected Sites, United States, 2003* states, "For most pathogens, the 2003 incidence of infection was lower than the average annual incidence for 1996–1998" (p. 11). It goes on to note that "the changes in the incidence of these infections occurred in the context of control measures implemented by government agencies and the food industry, enhanced food safety education efforts, and increased attention by consumer groups and the media" (p. 19). In other words, food safety programs, including changes in regulation, education and improved technology, are positively impacting food safety.

Reiterating concerns expressed in other reports, the *Preliminary FoodNet Data* report suggests that "efforts also should include steps to reduce contamination of fresh produce. The high incidence of several of these infections in infants and young children is of major concern."

Centers for Disease Control and Prevention (CDC) scientists in the United States warn against relaxing food safety efforts. The true number of foodborne illnesses is not known because of an undetermined amount of underreporting. (The CDC estimates that only one of every 37 foodborne illnesses is reported.). Mass production, widespread distribution and increased importation enable pathogens to spread more rapidly and broadly through the population than in times of local production and distribution. Scientists have been unable to determine the causes of a portion of foodborne illnesses possibly because they are caused by unknown pathogens.

## Reducing Risk

No food product can ever be entirely risk free. The risk associated with consumption of any food depends on the quantity of contamination consumed, the strength (toxicity) of the contaminant involved and the susceptibility of the individual(s) consuming the contaminant (e.g., age, level of health, status of immune system).

Although the overall number of foodborne illnesses declined during the last five-year period, the number of foodborne illnesses in fruits and vegetables has increased. In large part, this increase is due to the greater level of consumption of whole and minimally processed fruits and vegetables, changes in consumer demographics, and more intensive production, processing and handling practices.

## Implementation Rationale

Consumers and governments expect our food to be safe. Their expectations are not negotiable.

Traditionally, final product sampling has been used to identify suspect product. However, when pathogens are present, they are often randomly distributed at low levels, so they are extremely difficult to detect. This makes the cost of statistically valid sampling programs uneconomical. An example used by Dr. James Gorny of the International Fresh-cut Produce Association illustrates this point. According to Dr. Gorny, if pathogens are present on 5 per cent of the final product, in order to have a 95 per cent probability of finding that contaminated 5 per cent, 60 per cent of the final product must be tested. This involves prohibitive costs, and the testing process is often painfully slow.

Because there are no known processing procedures that will completely eliminate contamination in minimally processed foods, and because final product-testing programs are slow, costly and ineffective, universally recognized prevention systems have been developed to minimize the risk of hazard introduction.

## Food Safety Programs

Food safety programs are preventive systems designed to detect potential hazards before they occur and to implement control measures to reduce or eliminate the likelihood of their occurrence. Food safety programs may be divided into three general areas.

The first of these proactive systems is the application of Good Agricultural Practices (GAPs) during growing, harvesting, on-farm transportation, packing and storage. Examples of programs for specific commodities may be accessed through the Canadian Horticultural Council (CHC). Excellent programs have also been developed by Cornell University, the University of California Davis (UC Davis) and the United States Food and Drug Administration (USFDA). GAPs may be developed as a stand-alone program. These programs for produce growers are currently voluntary.

At the processing level, Good Manufacturing Practices (GMPs) are the basic, universal conditions and procedures within the processing establishment that create conditions favourable for the production of safe food. GMP requirements are largely common-sense practices. They include all physical aspects of the production facility environment, as well as operational management of food handler hygiene, sanitation, chemical use, equipment maintenance, pest control, water safety, shipping, receiving, storage and recall procedures. None are process specific. As with GAPs, GMPs may be developed as a stand-alone program. These programs for foods of plant origin processors are currently voluntary. However, processors may choose to undergo a CGSB audit to become *GMP Advantage* certified.

Standard Operating Procedures (SOPs) and Sanitation Standard Operating Procedures (SSOPs) are an essential part of GMPs. SOPs are detailed documents that specifically define how procedures will be performed. SSOPs are the written procedures that describe step-by-step cleaning and

## Components of a Food Safety System

**Good Agricultural Practices**
(GAPs)

*Practices used in the growing, harvesting, sorting, packing and storage operations to reduce contamination.*

↓

**Good Manufacturing Practices**
(GMPs)
(also called Prerequisite Programs)

*Basic, universal conditions and procedures within the processing establishment that create conditions favourable for the production of safe food. They control general hazards.*

- **Environmental Controls**
  - Establishment Location and Construction
  - Establishment Design
  - Establishment Interior
  - Equipment
  - Water Supply
- **Operational Controls**
  - Personnel Practices
  - Shipping, Receiving, Handling and Storage
  - Sanitation
  - Equipment Maintenance
  - Pest Control
  - Recall
  - Water Safety
- **Control Programs (written policies and procedures)**
  - Personnel Practices
  - Shipping, Receiving, Handling and Storage
  - Sanitation
  - Equipment Maintenance
  - Pest Control
  - Recall
  - Water Safety
- **Training**
  - Personnel Practices
  - Shipping, Receiving, Handling and Storage
  - Sanitation
  - Equipment Maintenance
  - Pest Control
  - Recall
  - Water Safety

↓

**HACCP**
**Hazard Analysis Critical Control Points**

*A worldwide recognized, science-based, preventative system designed to detect potential hazards before they occur and to implement control measures to reduce or eliminate the likelihood of their occurrence.*

sanitation procedures required in a GMP sanitation program. Both include who, what, where, when and why. Each is tailored to individual operations as part of the operation's food safety plan.

HACCP is the final step in implementation of food safety practices in an operation. **HACCP is not a stand-alone program.** Only after a GMP program is in place can a Hazard Analysis Critical Control Points (HACCP) plan be prepared. During the development of a HACCP plan, potential biological, chemical and physical hazards are identified in the manufacturing process. Control and monitoring measures are implemented at these critical control points (CCPs) to ensure that the identified hazards are reduced, prevented or eliminated. Actions taken are recorded.

Worldwide acceptance and recognition of HACCP as a method for food safety assurance increased dramatically with publication of the *Guidelines for the Application of Hazard Analysis and Critical Control Points System* by the Food and Agriculture Organization (FAO)/World Health Organization (WHO) Codex Alimentarius Commission in 1993. Since then, as HACCP has gained worldwide acceptance, the Codex Alimentarius Commission has continued to refine the HACCP system and guidelines for its application.

## Food Safety Program Accreditation

Until recently, only federally registered food processors could gain HACCP accreditation through the Canadian Food Inspection Agency's Food Safety Enhancement Program (FSEP). However, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has designed a HACCP program for non-federally registered food processors called *HACCP Advantage*. It was introduced in 2003.

The voluntary *HACCP Advantage* program is designed to be feasible regardless of the size, commodity or volume of production of an operation. It complements food safety regulations but does not replace them.

As of March 1, 2006, food processors that wish to have their *HACCP Advantage* program certified by the Canadian General Standards Board (CGSB) have three options:

- *GMP Advantage*: CGSB certification that the requirements for environmental controls, control programs, operational controls and training have been met. For many foods of plant origin processors, this may be all that is required.

- *HACCP Advantage*: Certification includes requirements of the *GMP Advantage* program plus a HACCP plan, as outlined in the *HACCP Advantage* guidebook.

- *HACCP Advantage Plus*$^+$: To achieve certification, requirements of *GMP Advantage*, *HACCP Advantage*, four standards relating to traceability and eight standards relating to security must be achieved.

This *Minimally Processed Fruits and Vegetables Good Manufacturing Practices Guidebook* is consistent with the format of the *GMP Advantage* program manual. However, rather than cover all commodities, it is designed specifically to deal with challenges specific to fruit and vegetable operations. OMAFRA recommends that all fruit and vegetable operations implement the programs described in this manual, regardless of whether or not they plan to seek formal *GMP Advantage* certification.

## The Economics

The benefits of food safety programs are many. Some are tangible, money-in-your-pocket kinds of rewards, while others are less easily measured.

Implementation of effective food safety and quality control programs require critical examination of every aspect of facility environment and operations. This greater level of control generally leads to enhanced production efficiencies including higher production levels, increased yields resulting from less product waste, a reduced requirement for product rework, a more consistent product and increased shelf life. Less easily measured is the financial and emotional impact of fewer crises and freed management time. These tangible benefits are additional to increased protection from financial loss caused by unsafe product, increased credibility with buyers and the resulting potential for larger market share.

Obviously, certain costs are involved in the implementation of a food safety program. Some will be one-time costs (e.g., facility and/or equipment upgrades, developing and implementing programs) and some will be recurring (e.g., training, monitoring and record keeping). The number of products, the complexity of the processing procedures and the number of potential food safety hazards to be addressed also affect cost.

Ongoing economic studies suggest that long-term financial benefits of a GMP program generally outweigh the added costs. Therefore, an effective GMP program should be considered an investment in the business, not a cost of doing business.

## E1 ESTABLISHMENT LOCATION and CONSTRUCTION

**Property and Surroundings**

**E1.1 The establishment is located away from or protected against potential sources of external contaminants that may compromise the safety and suitability of food. Areas surrounding the establishment are maintained to prevent or minimize harbourage of pests and contaminants.**

**Location**

Ideally, production facilities should be located away from areas where atmospheric dust (e.g., dust from parking lots, driveways or fields), smoke, objectionable odours (e.g., industrial manufacturing facilities or intensive livestock operations), airborne chemicals (e.g., pesticides or industrial pollutants) or vehicle exhaust pollution are present. Any of these pollutants may permeate the facility and contaminate food, food contact surfaces or food packaging materials with microorganisms, chemicals, dirt or other extraneous material. Environmentally polluted locations (e.g., old landfill or toxic waste sites) should also be avoided as building locations. Areas that are prone to infestations of pests (e.g., sites near swampy areas) should not be considered as building sites, nor should areas that are susceptible to flooding.

**Drainage**

Standing water may result from poor drainage or occasional flooding of grounds, driveways or parking lots. This water may promote the proliferation of insects (e.g., breeding area for mosquitoes) and pests (e.g., source of drinking water for rodents, birds including seagulls and pigeons, raccoons, or reptiles). Standing water also encourages microbial contamination by generic *E. coli* that may be carried into the facility on mud and dirt by foot traffic, equipment or pallets. In addition, control of exterior water minimizes the potential for contamination by seepage into the facility.

**Grounds Maintenance**

Grounds should be maintained. Debris, garbage, unused equipment, pallets, containers, tall vegetation and raw materials stored outside the facility encourage breeding and harbourage of pests such as mice, rats, raccoons, insects, birds, skunks, snakes and other wildlife. All may enter the building and contaminate food, food processing or food storage areas.

Vegetation surrounding the facility should be kept closely trimmed to a distance of at least 6 m from the facility. Garbage and other debris should be picked up immediately and placed in covered, pest-resistant containers.

Supplies and equipment stored outside the building should be neatly stacked, elevated at least 15 cm off the ground, or stored on concrete slabs and located at least 6 m from the facility to discourage rodent and insect harbourage. Pipes stored within 6 m of the facility should have the ends sealed to prevent pest entry.

### Pest Deterrents

Mice and rats are discouraged by open spaces. A strip of vegetation-free, debris-free gravel a minimum of 75 cm wide and 10 cm deep around the perimeter of the production facility will discourage rodent entry. The wider the perimeter strip, the better. This strip is also an excellent location for traps and bait stations. (See Section O5 for more details regarding pest control.)

Minimize roosting and nesting sites on and near the production facility to discourage birds.

Outside lights should be located on standards away from the facility, not on the building. This will minimize insects swarming near open doors and windows after dark. Insects are less attracted to lights containing low ultraviolet levels.

Solid and liquid wastes should be stored in non-leaking, covered containers placed on concrete slabs. Exterior waste containers should be located far enough away (at least 10 m) from the production facility to discourage rodent travel between the two. Frequent emptying of waste containers (before they overflow or a minimum of once per week) will minimize their appeal to pests (e.g., rats, mice, flies, seagulls, etc.) and reduce odours. Areas around waste containers should be kept clean to make the area less attractive to pests and to minimize the potential for cross-contamination (e.g., by wheels of forklifts, shoes, etc.).

### Roadways

Paved driveways and parking areas are ideal. Where this is not possible, roadways should be properly graded, compacted and free of dust. Dust from unpaved driveways may be controlled with environmentally friendly dust suppressants (e.g., Tembec Dust Supressant®, a non-toxic, biodegradable ammonium lignosulphonate pulping liquor). Calcium chloride is the most commonly used dust suppressant, and petroleum mixtures are also effective, but both are less environmentally safe. The Ministry of the Environment must approve all dust suppressants used in Ontario.

Paved grounds and driveways should be swept (or washed) regularly to prevent dust and other potential contaminants from blowing into the building and transport vehicles. For large areas, a street sweeper can be an effective tool.

## Building Exterior

**E1.2 Establishment exterior is structurally complete and suitable for the operations taking place within. Establishment exterior is protected against entry or harbourage of pests as well as entry of external contaminants.**

### Structure

Regardless of whether the facility is new or renovated, the exterior should be constructed of durable, weather-resistant materials. It should also be structurally sound and in good repair.

The design and construction of all facilities must conform to local building regulations. Information about the Ontario Building Code, the latest Code developments, and advice on interpreting Code requirements may be found at www.obc.mah.gov.on.ca/scripts/index_.asp.

### Pest Deterrents

Openings in walls, foundations, eves and the roof should be screened or sealed, as appropriate, to prevent entry of the outside elements (e.g., rain, snow), airborne contaminants (e.g., dust, smoke, odours), and pests (e.g., mice, pigeons, raccoons). Facility design and construction should also discourage harbourage of insects, birds, rodents and other vermin by minimizing exterior ledges, nooks and crannies where pests can feed, nest, travel and hide.

Facility doors and windows should be kept closed. When this is not possible, they should be screened (22 mesh or finer is suggested). All doors and windows should be tight, with cracks not exceeding 6 mm in height or width. Doors opening to the outside should be equipped with brush seals and should be fitted with self-closing devices. The use of air curtains provides extra protection against pest entry.

Dock doors should be kept closed to prevent bird, rodent and insect entry. Brush seals on dock leveller plates will discourage rodent entry. Dock canopies should be designed and constructed to deter birds roosting and nesting. Areas near the dock should be kept free of debris and spilled products. Dock door seals will prevent potentially contaminating runoff water from truck and trailer roofs entering the facility or dripping on product or raw materials as they are loaded or unloaded.

Exposed outside drains should be screened to prevent pest entry into the facility.

**Security** Security at food production facilities has recently received increased attention, especially in the United States. In some circumstances, improved security measures may be necessary to prevent entry of visitors who may intentionally or unintentionally contaminate the facility and/or food products. This may require a policy of new employee screening, restricted visitor entry, employee identification badges, a facility security system, perimeter fencing, exterior lighting or other measures.

## E2 ESTABLISHMENT DESIGN

**Cross-Contamination Control**

**E2.1 Establishment design or operational controls permit hygienic activities, including protection against cross-contamination of food, ingredients, packaging materials and food contact surfaces.**

In simple terms, cross-contamination control means controlling the transfer of microbiological, chemical and physical hazards **into** the facility and controlling the transfer of microbiological, chemical and physical hazards from one area to another **within** the facility. This can be accomplished by facility design and by controlling movement of people and materials in the plant.

**Separation**

Facility design must separate incompatible operations to minimize the potential for cross-contamination between ingredients, food contact surfaces, packaging materials and finished food products. This may be achieved by:

- Physical separation (zone isolation)
  - Separate rooms for food processing, ingredient storage, and chemicals used for cleaning and sanitation, or
  - Adequate physical separation of designated work areas to prevent cross-contamination.
- Operational separation
  - Scheduling incompatible operations at different times with sufficient time between operations to clean and sanitize, or
  - Using dedicated equipment).

In production facilities that process multiple products, cleaning and sanitation should take place in the time between different production processes if possible. When this is not possible, scheduling activities with a higher risk of contamination after those of lower risk (e.g., minimally processed or raw product following cooked product) will help minimize potential cross-contamination.

**Food Handler Traffic Flow**

Control of employee traffic flow is an effective way to avoid cross-contamination between different production areas. Employee shoes and boots, equipment (e.g., forklifts, handcarts, carts), and transportation devices (e.g., pallets, bins, etc.) may be a serious source of microbial, chemical or physical contamination.

Traffic flow should be designed in such a way that employees do not pass through other production areas to get to their designated area. Ideally, employees should enter their designated work area from a change room or common hallway and pass through a foot sanitizer. Where direct entry is impossible, traffic flow should always be from "cleaner" areas to "dirtier" areas. To facilitate traffic flow in the opposite direction, ("dirty" to "clean"), facility design should incorporate areas where employees can change clothes and footwear between production areas. Facility design should also provide foot baths or sanitizing floor foamers at each entrance and an adequate number of strategically placed handwashing stations.

The flow of people and product and potential points of cross-contamination can both be identified in a facility schematic. If blueprints are available, they can be substituted.

- Identify each work area or room and the position of each piece of equipment.
- Plot the flow of people, ingredients, food products, packaging, chemicals, waste, etc. throughout the facility. Use different coloured arrows or different styles of dashes to distinguish the flow of each. Verify the accuracy of your diagram by walking through the plant during production.
- Identify the points of potential cross-contamination (biological, chemical and physical).
- Use the diagram to design improved traffic flow patterns.

It is sometimes helpful to identify acceptable employee traffic areas with wall signs or floor-painted routes. Travel in "restricted" areas can be discouraged by physical partition of storage, processing, and packaging areas. Except for emergency exits, the number of entry/exit doors should be limited to discourage traffic. Fewer entrances also minimize the expense of additional entrance equipment (e.g., floor foamers) and personnel supplies (e.g., fewer changes of hair nets, gloves, beard covers, etc. are required).

**Ingredient/ Product Flow**

Flow should always be directly from one production area to the next with no backtracking or crossovers of "raw" products and/or ingredients with finished products. Ingredients should be brought directly from storage areas to the production area where they will be used. As with employees, they should not travel through another production area to get there.

**Equipment/ Utensil Movement** The same rules that apply to human traffic patterns should also apply to equipment traffic patterns. Equipment (e.g., forklifts, handcarts, carts) and transportation devices (e.g., pallets, bins, etc.) should be restricted to designated areas. This will lessen the potential for tracking pathogen-containing material from one part of the facility to another. Equipment used for moving ingredients, packaging material and finished product throughout the facility should also be kept clean and maintained in good condition. When passing from "dirty" to "clean" areas, driving through floor foams will help sanitize tires.

**Waste Flow** Waste should never move through food processing, handling or storage areas when there is risk of contamination or cross-contamination with food, ingredients or packaging. Waste must never pass over production or packaging lines. To avoid cross-contamination with employees and equipment, care must be taken not to spill waste while emptying containers.

Liquid waste (e.g., wastewater and sewage) systems must be of adequate size to handle operational volumes. Wastewater drainage and sewage systems should be equipped with appropriate traps and vents, fully separated so there are no cross-connections and clearly identified as to their function. These lines should not pass over or through production areas unless stringent precautions have been taken to prevent contamination in the event of leakage. In the event of a backup of wastewater or sewage, the affected areas must be thoroughly cleaned and sanitized before production resumes, and contaminated ingredients, packaging and products discarded.

**Colour Coding** Colour coding is an effective way to reduce the potential for cross-contamination by microorganisms.

Establish an area in which a specific processing step will take place. Designate a colour for all food handling utensils, tools, and workers' gloves and hairnets. Designate another colour (or variation of the food handling colour) for all cleaning and sanitation tools that will be used in that same area. These colours and these colours only should be used in the defined area.

**Utensil Cleaning Area** In order to prevent contamination, cross-contamination and recontamination, it is often necessary to clean and sanitize utensils and disassemble smaller equipment in a physically separate area or room. This area must be in a location convenient to the production area but one that does not require travel through other production areas to access.

The walls, floor and ceiling should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. A list of acceptable materials is published by the CFIA. The *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* may be accessed at www.inspection.gc.ca/english/ppc/reference/u2e.shtml. The area must be well ventilated. It should be supplied with sufficient quantities of hot and cold water at adequate pressure. Floors must be sufficiently sloped to allow water to drain to trapped, cleanable drains, and drainage lines should be large enough to carry peak loads of effluent. Design and construction must comply with local building codes.

## Personnel Facilities

**E2.2 Washrooms, change rooms, and lunch and break area(s) are provided and maintained to ensure that personal hygiene can be maintained to protect the safety and suitability of food. Washrooms are equipped with adequate lighting and an adequate number of flush toilets and handwashing stations; are free of condensation, excess moisture or odours; and are designed to prevent or minimize contamination.**

Employee facilities should include washrooms, change rooms and a separate eating area. All should be designed and constructed to permit easy cleaning and sanitation and to encourage personal hygiene. Dirty facilities may unintentionally contaminate food handlers who, in turn, can contaminate ingredients, packaging materials and finished products.

All personnel facilities should not open directly into food processing areas, should be equipped with proper ventilation, and should have automatic self-closing doors to minimize hand contact with contaminated knobs and door surfaces.

The floors, walls and ceilings of all washrooms, change rooms and lunchrooms should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant material that is able to withstand repeated cleaning. (See www.inspection.gc.ca/english/ppc/reference/u2e.shtml for a list of acceptable materials.) Floors should slope to functioning drains. If possible, toilets, partitions, sinks and other fixtures should be wall mounted to permit easy and thorough floor cleaning and sanitation. Tables and chairs in change and lunchrooms should be hard surfaced for ease of cleaning. All employee facilities should be cleaned daily.

Handwashing is the single most effective way to prevent the spread of communicable diseases. Sinks must be supplied with potable (suitable for drinking) water in adequate quantity and pressure. If possible, both hot and cold running water should be available with knee, thigh, foot or electric sensor controls so employees are not required to touch the taps after washing their hands. Where "hands-free" tap controls are not present, employees should close the tap control with their used single-use towel to avoid direct contact with their clean hands.

Single-use towels are the preferred method of hand drying. The rubbing action required to dry hands with single-use towels also removes microbes from hands. Common-use cloth towels become contaminated quickly and should never be used. Air dryers may recontaminate freshly washed hands with airborne contaminants.

Towel dispensers should be "hands free" so food handlers can pull out paper towels without touching the dispenser. Handwashing notices and instructions in languages appropriate for the employees should be posted in the washrooms.

Each sink should be equipped with liquid soap in a pump dispenser. Where appropriate, a hand sanitizer may also be provided. An adequate number of lined waste receptacles should be present, and they should never be allowed to overflow. Unlined waste receptacles should be cleaned after every emptying to discourage odours and pests.

Washrooms should have an adequate number of sinks and toilets for the number of people using them (a maximum 20 people per toilet is suggested. A fan, exhausting to outside the facility, should be connected to the light switch so when the washroom is in use (the light is turned on), the fan creates negative air pressure within the room. Lighting intensity should be 220 lux (20 foot candles) or greater to facilitate sanitation procedures (you can't properly clean what you can't see). See Section E3.2 for more lighting information.

As noted earlier, the design and construction of all facilities must conform to local municipal building regulations and the Ontario Building Code. Information about the Ontario Building Code, the latest Code developments and advice on interpreting Code requirements may be found at www.obc.mah.gov.on.ca/scripts/index_.asp.

Ideally, washrooms should be located only in break areas and separated from production areas so doors do not open directly into a food production/ packaging area. Preferably, doors should be self-closing so employees do not have to touch them after washing their hands. There should be an adequate number of hangers outside the entrance so that employees can remove protective clothing (aprons, gloves, etc.) before entering the washroom.

If a washroom is located immediately off a production or packaging area, in addition to the self-closing doors and clothes hangers noted above, entrance/exit equipment (e.g., foot bath) and personal supplies (e.g., hair nets, gloves, beard covers, etc.) must be provided.

A lockable locker or secure location should be provided for each employee. This will provide a safe place for personal belongings (e.g., jewellery) and discourage its presence in production areas. Lockers should be constructed of non-porous, cleanable material. They should be equipped with door vents to facilitate air flow into the locker. Locker tops should be sloped at 60° to prevent dust collection and use as a storage area.

Change rooms should also be cleaned daily. Lined garbage containers should be emptied daily and cleaned, if necessary. Soiled laundry should be collected in clearly marked, closed containers and removed regularly for cleaning.

Provisions should be made to store employees' lunches in the lunchroom. A glass-door display-type refrigerator will store lunches safely, deter theft and discourage pests. Employee food should never be stored in lockers. Lined garbage containers, especially those containing discarded food, should be emptied and cleaned regularly.

## E3 ESTABLISHMENT INTERIOR

**Internal Structures and Fittings**

**E3.1 Internal rooms, structures and fittings are suitable and are maintained for the operations taking place within. Floor, ceilings, overheads, doors, windows, stairs and other structures are cleanable, properly maintained, exhibit no evidence of degradation that would cause contamination and are suitable for the activities in each area. The condition of internal rooms, structure and fittings protects the safety and suitability of food.**

A poorly designed facility may be difficult or impossible to keep clean. Attention to sanitation requirements during the design process can save time and resources and prevent problems later. Good design will also enhance production efficiencies.

The design and construction of all facilities must conform to local building regulations. Information about the Ontario Building Code, the latest Code developments and advice on interpreting Code requirements may be found at www.obc.mah.gov.on.ca/scripts/index_.asp.

**Floors**

Floors should be waterproof, non-absorbent, washable, non-toxic, easy to clean and sanitize, and durable for their intended use (e.g., some environments may be wet and corrosive while others may alternate between hot and cold). Floor surfaces should be textured enough to prevent slipping but smooth enough to allow for thorough cleaning. If floor coatings or tile are used, they must be inspected regularly for cracks and crevices and/or other damage. Cracks and crevices can create an environment (e.g., trap moisture and debris) suitable for microbial growth.

To prevent water pooling and potential microbial growth, floors should be smooth and have a continuous slope toward trapped drains. A 1–2 per cent slope is suggested. Areas that do not drain well must be mopped or squeegeed regularly to minimize pooling and the potential for cross-contamination. Because floor drains can sometimes harbour pathogenic microbes (e.g., *Listeria*), drain covers should be easily removable to facilitate regular cleaning.

If floor mats are used, they should be readily removable and be constructed of easily cleaned material.

**Walls and Ceiling**

All internal surfaces, structures and fittings should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. As a minimum, walls should be smooth, waterproof and easy to clean to a height appropriate for the operation. Light-coloured walls and ceilings are most easily monitored for the presence of soil.

Growth of microorganisms or mould may result if walls and ceilings cannot be effectively cleaned. Materials that are not durable or suitable can deteriorate, resulting in physical contamination of food by flaking, peeling or rusting. The use of materials that cannot be adequately cleaned and disinfected should be avoided. The use of wood, even when a smooth, impervious material covers it, is not recommended. A list of acceptable materials may be found in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* published by the Canadian Food Inspection Agency. It may be accessed at www.inspection.gc.ca/english/ppc/reference/u2e.shtml.

Structural seams, cracks and crevices in walls and ceilings should be sealed to thwart entry of insects and rodents and to inhibit debris collection and microbial contamination. The area where the wall meets the floor should be "coved" (rounded at a 2.5 cm radius or sloped at a 45–60° angle) to increase cleaning effectiveness. Installation of wall "bumpers" will lessen damage by forklifts, pallet jacks and other moving devices. Damage-caused holes can permit entry of pests and other contaminants. Bumpers and sloped curbs should also be sloped at a 45–60° angle.

Production facilities should have solid ceilings that cover areas where dirt can accumulate (e.g., rafter chords), birds can roost, and pests (e.g., rats, raccoons, pigeons) can nest and/or travel. Physical debris and microbially contaminated feces can fall from overhead structures, platforms, ladders, stairs, chutes, overhead utility installations, piping, etc. Areas where dirt and debris accumulate must be cleaned regularly. Ladders and walkways over production areas should be equipped with kick plates at least 10 cm in height to protect exposed food, ingredients, food contact surfaces and packaging materials.

Pipelines, electrical conduit, air lines and ducting should be mounted away from the ceiling to allow for cleaning and should be insulated to eliminate condensation. Only smooth hanger rods should be used instead of angle iron or threaded rods that can collect dust and soil. As an alternative, these service lines can be structurally enclosed at the ceiling or in the attic.

Ceilings should be designed so they minimize condensation (e.g., insulated) and hard surfaced so they do not absorb moisture, which encourages mould growth. Ceilings should be constructed from materials that do not flake or peel and are easy to clean.

Any painted or coated surfaces should be inspected often for signs of chipping, peeling, flaking or other loose particles. Repairs should be made immediately to eliminate these physical hazards.

**Windows and Doors**

Windows should be tight fitting to prevent entry of pests and airborne contaminants. Window sills and ledges should be sloped at 45–60° to lessen the accumulation of dust and dirt and to discourage their use as a shelf.

Windows that do not open should be sealed. Windows that open must be fitted with screens fine enough (22 mesh or finer is suggested) to not only prevent entrance of insects but also allow easily removal for cleaning. Windows (both interior and exterior) that view food processing areas should not be opened. Repair damaged windows and screens promptly.

When possible, windows should be constructed of unbreakable material. Where glass windows are installed, they should be protected against breakage to minimize the potential for contamination by broken glass.

Doors should have smooth, non-absorbent surfaces, be easy to clean and sanitize, and be able to withstand normal use and cleaning. They should be wide enough to allow product and vehicles to pass through without contacting (and potentially damaging) the door frame. Exterior doors, cold storage room doors and production area doors should be self-closing. All doors must be tight fitting and may be equipped with brush seals to discourage pest entry. A mouse can gain entry through an opening the width of a lead pencil (6 mm).

**Dry Storage Areas**

Establishment interior requirements also apply to storage areas. Floors should be waterproof, non-absorbent, washable, non-toxic, easy to clean and disinfect, and be properly drained. All internal walls, ceilings, structures and fittings should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. Paint may be used in this non-production area only if it is the only practical solution for a smooth, easily cleanable surface. However, surfaces must be free of chipping, peeling, and flaking paint, or other loose particles.

Doors should be tight fitting and easy to clean and sanitize. Windows also should be tight fitting and protected against breakage if not constructed from unbreakable material. Lighting should be of the correct intensity (see Section E3.2) and protected against breakage. Ventilation systems should be adequately screened and designed to remove excess heat and humidity without cross-contamination (see Section E3.4).

**Coolers/Freezers**

Establishment interior requirements also apply to the interiors of coolers and freezers. Floors should be waterproof, non-absorbent, washable, non-toxic, and easy to clean and disinfect, and be properly drained. All internal walls, ceilings, structures, and fittings should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. Doors should be tight fitting and easy to clean and sanitize. Lighting should be of the correct intensity and shielded to prevent accidental breakage.

Cooler and freezer loading doors should be equipped with PVC curtains that overlap at least 13 mm to help maintain cooler/freezer temperature when the door is open. Because they drag across ingredients, food products and equipment as it moves in and out of the cooler, these curtains have the potential to cross-contaminate. For this reason, they should be cleaned and sanitized regularly.

Coolers and freezers should be free of condensation. However, in case of equipment failure or loss of power, condensation collection pans and/or drain pans should be located beneath refrigeration equipment, coils, and pipes to protect food and/or food ingredients. Regular inspection and cleaning of these collection pans is required.

The key to cold chain management is frequent temperature measurement. Monitoring may be accomplished either manually or with an alarmed temperature tracking system. Thermometers should be calibrated regularly following manufacturer's directions. Refrigeration equipment should be kept in good repair. Instead of one large unit, many operators use two smaller refrigeration units in order to maintain some degree of cooling in the event of the failure of one.

Too high temperatures can hasten fruit and vegetable ripening and their subsequent deterioration. This accelerated bacterial and fungal spoilage creates a potential food safety hazard. Reducing storage temperatures can slow deterioration. Controlled atmosphere (CA) can also slow deterioration when used in conjunction with storage temperature levels most appropriate to the particular fruit or vegetable. A further strategy may be removal of ethylene gas (the "ripening hormone") from the cooler where climacteric fruits and vegetables (e.g., apples, cantaloupes, honeydew melons, peaches, pears, tomatoes, watermelons) are stored. Adequate ventilation and/or ethylene scrubbers will remove ethylene, thereby minimizing its effect in quickening the rate of ripening.

## Lighting

**E3.2 The establishment has appropriate lighting to facilitate all activities including processing, inspection, cleaning and sanitizing, and maintenance. Lighting is of a design and type that does not contribute to a misleading assessment of food.**

In sorting, inspection and grading areas, the quality of light is important in order to determine true food colour. Natural light is best, but often an impractical lighting option. Most fluorescent and incandescent light bulbs generate only a portion of the full light spectrum. This results in a misleading evaluation of food colour. In areas where true food colour evaluation is required, full-light-spectrum bulbs should be used.

Lux is the metric measurement unit for light intensity. One lux equals the total intensity of light that falls on a 1 sq. m surface that is 1 m away from a one-candle-power light source. Under the Imperial system, one foot candle equals the total intensity of light that falls upon a 1 sq. ft surface that is placed one foot away from a point source of light that equals one candle power. Since there are 10.76 sq. ft per sq. m, there are 10.76 lux per foot candle.

It is recommended that lighting intensity should not be less than:

- 540 lux (50 foot candles) in food processing and inspection areas
- 220 lux (20 foot candles) in work areas
- 110 lux (10 foot candles) in storage and other areas including change and washrooms.

Light intensity should be checked at least twice per year.

## Lighting Fixtures

**E3.3 Light bulbs and fixtures in areas of exposed food, ingredients, packaging materials or food contact surfaces are equipped with shatterproof bulbs or breakage shields to prevent or minimize contamination of food if breakage occurs.**

Lighting fixtures must be securely suspended or fastened to the ceiling so they cannot fall onto food, processing lines or people.

Light bulbs and fixtures over food, ingredients, packaging materials and food contact surfaces should be equipped with shatterproof bulbs or be protected with an unbreakable shield to trap fragments in the event of bulb breakage. Bulbs should also be protected against accidental breakage.

All fixtures and bulbs should be easy to clean. Regular cleaning will ensure that they do not contribute to contaminants falling on to food, ingredients, packaging materials and food contact surfaces. Cleaning will also maintain light quantity and quality.

The cleanliness of lights should be monitored during regular premise inspection.

## Air Quality and Ventilation

**E3.4 The establishment has and uses ventilation to keep rooms free of excessive heat, humidity, steam, vapours, smoke, particulates and condensation. Ventilation openings have screens or filters that can be easily cleaned or changed. Ventilation systems do not permit air to flow from contaminated areas to clean areas.**

The volume of air exchange should be adequate to prevent excessive heat, steam, vapours, smoke, condensation and dust; to discourage the growth of mould and mildew; and to remove contaminated air. Either a natural (e.g., open screened windows) or a mechanical system may be employed. Natural ventilation is not a realistic option in large or sensitive food handling areas.

Air intakes should not be located in areas where they may take in contaminated air. Intakes, including those for air compressors, should be equipped with tight-fitting screens and filters. Very fine filters (e.g., 0.1 microns) will remove airborne bacteria, yeast, mould and some viruses. Screens and filters should be easy to remove for cleaning or replacement and should be serviced regularly.

Fans, air ducts and other ventilation equipment should be kept clean and well maintained. It is a good practice to test interior air regularly for biological, chemical and physical contaminants.

Pneumatic equipment systems (e.g., air compressors) should be fitted with an air dryer(s) to remove water and an air filter(s) to remove water, oil, oil vapour, dust and other contaminants. Filters should be monitored/cleaned regularly. As with facility air, air in the pneumatic system should also be tested regularly for contaminants.

In microbiologically sensitive areas, a positive air pressure system should be used (outdoor air is drawn in and the increased pressure forces stale, potentially contaminated indoor air out of the room). Positive air pressure should be highest in the packaging area and progressively lower back through to the receiving area. In this scenario, the direction of airflow is always from a microbiologically "clean" area (e.g., packaging) to a "dirtier" area (e.g., receiving).

## Drainage and Sewage Systems

**E3.5 The establishment has and uses drainage and liquid disposal systems that are maintained to protect the safety and suitability of food and potable water supply. Drainage and liquid disposal systems are equipped with back-flow preventers and no cross-connections exist with drainage or waste systems and potable water lines. Pooling of water and liquids is prevented or addressed.**

There should be an adequate number of floor drains to effectively drain liquids. A suggested guideline is one floor drain per 40 sq. m of floor area. The minimum recommended drain cover size is 30 cm$^2$. Drains can harbour *Listeria* and other pathogens, so drain covers should be easily removable to allow regular cleaning.

Floors must be adequately sloped toward the drains. A uniform floor slope of one to two per cent (2–4 cm) toward the drain is suggested. Always check with your local municipal building department before beginning new construction or undertaking renovations.

All drains should be trapped and vented and of adequate size to carry peak drainage loads. A minimum diameter of 10 cm is recommended. Where trench drains are used, they should flow from "cleaner" to "dirtier" areas.

Potable and non-potable water (effluent) systems must also be completely independent of each other and of sewage systems.

Potable water pipes should be clearly identified (e.g., colour coded) to avoid confusion with those carrying wastewater and sewage. Water systems should be equipped with back-flow prevention devices to prevent potential siphoning of contaminated liquids into the potable water supply (e.g., by hoses left lying on the floor).

Waste disposal systems should be constructed of corrosion-resistant material and be well maintained. Design should be such that there is no risk of cross-contamination of the potable water supply. The sewer system should not be interconnected with the food production drainage (effluent) system in order to reduce the potential for cross-contamination in the event of a malfunction (e.g., sewage backup into production areas).

Effluent or sewage lines should not pass over or through production areas where leaks could contaminate food, ingredients, packaging materials and food contact surfaces. However, if they do, covering these lines or placing a catch-trough below is not recommended. Such devices serve only to camouflage leakage problems that require immediate attention. In the event of a backup of wastewater or sewage, the affected areas must be thoroughly cleaned and sanitized before production resumes, and contaminated food products, ingredients and packaging materials discarded.

In contrast to effluent or sewage lines, overhead water lines that may create condensation should be wrapped with insulation and covered with a plastic sleeve.

Equipment drain lines should not discharge into work or traffic areas or into areas that are difficult to clean.

All drainage and sewage discharges must meet local building code regulations.

## E4 EQUIPMENT

### Equipment Design, Construction and Installation

**E4.1 Equipment and utensils that may impact on food safety are constructed of non-toxic materials, exhibit no signs of degradation that could contaminate food, and are easy to clean, sanitize and maintain. Equipment design, location, construction and installation promote effective assessment, maintenance, and cleaning and sanitizing activities. Adequate equipment or facilities are available for the activities conducted to protect the safety and suitability of food. Equipment functions in accordance with its intended use.**

Equipment should be designed, constructed and installed so that it performs its intended function; is accessible for cleaning, sanitizing, maintenance and inspection; and minimizes the potential for biological, chemical and physical contamination during operations. This applies to all holding, conveying, processing, and packaging equipment and utensils.

Design deficiencies (e.g., microbial growth niches) must be operationally managed. The fewer the number of design deficiencies, the lower the number of corrective people-dependent procedures required during operations.

All food contact surfaces must be non-toxic, non-reactive and non-contaminating to the food. Surfaces must also be non-absorbent, smooth, corrosion resistant, easily cleanable and able to withstand repeated cleaning without deterioration for the lifetime of the equipment. To avoid creation of corroded or pitted areas where microbes can hide, live and survive, equipment must be constructed of materials that are compatible with the product being produced, cleaning and sanitizing chemicals being used, and procedures used during cleaning and sanitation. In most instances, this means that food contact surfaces must be constructed of stainless steel (300 series) or food-grade plastic. Avoid using wood and other similar materials that cannot be adequately cleaned and disinfected. The use of soft metals, those subject to corrosion, and painted surfaces is not recommended.

A list of acceptable materials, coatings and paints published by the CFIA may be found in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at www.inspection.gc.ca/english/ppc/reference/u2e.shtml. Those without Internet access should contact their local CFIA office (listed in the federal government section of the telephone directory Blue Pages).

Equipment should have a simple, open design that permits ready access for inspection, maintenance, cleaning and sanitation. All enclosed equipment should have an adequate number of inspection and cleanout doors. For ease of accessibility, equipment components should be easy to dismantle without specialized tools. Equipment design should also minimize opportunities for product and moisture accumulation and eliminate points where microbes can enter, grow and reproduce.

An article outlining ten principles of sanitary equipment design developed by the American Meat Institute (AMI) may be accessed at www.foodsafetymagazine.com/issues/0306/colclean0306.htm. While the article applies specifically to meat plants, among buyers there are rising expectations for the same equipment design standards in fruit- and vegetable-processing facilities.

**Surfaces** Food contact surfaces of both equipment and utensils should be free of niches such as crevices, stress cracks, open or gaping seams, pitted surfaces, bolt rivets, protruding edges, roll-under edges, recesses and creases that can trap food residues and encourage microbial growth. For the same reason, there should be no dead ends or dead spaces. There should be no evidence of, or opportunity for, rust or mould.

Welds should be continuous, ground smooth and polished to the texture of adjoining surfaces. Surfaces should be butt-welded to reduce microbial hiding places often found when overlap welding is used. Caulking, rather than continuous welds, is **not** acceptable.

The use of rivets, bolts, studs or tack welds to attach mounting plates, brackets, junction boxes, nameplates and end caps creates an entry point for water and a harbourage site for microorganisms. Whenever possible, continuous welds should be used instead of fasteners.

Inspection doors and control devices such as push buttons, switches and valve handles should be designed, constructed and installed in such a way that they do not allow penetration or accumulation of food materials or moisture, which encourages microbial growth. The same stipulations apply to electrical control panels, junction boxes, chain and belt guards, etc. Each enclosure should be sloped on top to prevent use as a storage and/or dust-gathering area.

The use of polyvinyl chloride (PVC) piping should be restricted to non-food use because the porous interior wall of this type of pipe may harbour microbes.

**Connections** Connection joints and overlapping parts provide excellent places for contaminants to hide but do not allow adequate room for cleaning water to force out microbe-harbouring food particles. Where welding is not feasible, bolts through stainless steel spacers should be used to hold parts tightly together while keeping food particles and microbes from hiding and allowing plenty of space for wash water. Domed stainless steel nuts or nuts with plastic tops and bottoms should cover bolt threads to block microbes from growing on unexposed threads.

**Drainage Holes** Accumulated water or product liquid can harbour microorganisms and create an environment for their growth. Cleaning and sanitation chemicals may also pool on equipment, causing a chemical contamination risk. To prevent this, equipment drain holes should be adequate in number and size and strategically located to allow easy, unobstructed liquid and product drainage.

**Conveyor Belts** Frayed conveyor belts can also be a source of physical and microbial contamination. Smooth, non-porous modular plastic or stainless steel belts do not fray and are easier to clean than flat belts. Hinges on modular belts should open wide enough around the sprockets to allow cleaning water access to all areas but be tight enough on the surface to prevent food particle accumulation.

**Working Space** Equipment should be installed with enough working space to permit inspection, facilitate ease of cleaning and sanitation either in place or disassembled, and allow maintenance and lubrication. To allow access for cleaning, equipment should be separated by 45–90 cm and should be installed at least 75 cm from walls, 20 cm above the floor and 45 cm below the ceiling.

Motors and drives should be mounted to the side or below food contact surfaces (30 cm below food level is generally suggested as a suitable distance). If motors can be mounted only above food, drip pans must be installed under the motor/drive to catch leaking lubricants. For these pans to be effective, they must be inspected and cleaned regularly.

**Motors, Drives** Where possible, bearings should be self-lubricating and sealed. Where lubrication is required, only food-grade lubricants that will not contribute unacceptable contamination must be used. The CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* provides a list of acceptable lubricants. It may be accessed at www.inspection.gc.ca/english/ppc/reference/u2e.shtml.

Faulty shaft seals on production equipment may allow product to leak outside the line, where microbial growth can occur. These microorganisms may grow then back to the product side of the seal. To prevent the passage of microorganisms, double seals with microbiocidal barrier liquids should be used. However, if these barriers are not replaced on a timely basis, they may also become a growth medium for microorganisms. Worn and/or cracked gaskets are also excellent sites for microbial harbourage and contamination.

Motors should be fully enclosed, splash-proof, explosion-proof and sealed to prevent contamination by moisture, dust and pests, and to lessen the risk of food contamination and of personal injury to employees. Drives, pulleys and other rotating parts should be covered for the same reasons. Whenever possible, direct-drive motors should be used instead of a chain-driven gearbox combination. Splash and safety guards should be easily removable for cleaning. All moving parts should be designed to be easily repaired or replaced with minimal disruption to production and low contamination risk to product in the event of mechanical failure.

**Support Structures** To avoid collection of dust, horizontal equipment structural supports should be constructed of round tubing or set diagonally if square tubing or angle iron is used. Upright floor supports should be free of floor flanges where microbes can hide and grow in residue accumulation.

Framework should be constructed so that moisture and soil cannot penetrate. Hollow areas (e.g., frames, rollers, etc.) that cannot be eliminated should be permanently sealed.

**Controls** Pipe valves, equipment "kill" switches and operating controls should be easily accessible and easy to operate should there be a leak or mechanical malfunction. Quick stoppage will result in less contamination and less product loss.

Wall-mounted control boxes, switch boxes, electrical conduit, sinks, pipes, etc. should be mounted away from the wall for ease of cleaning (a minimum of 2.5 cm is suggested). Where direct wall mounting is unavoidable, caulking may be used to prevent microbial and/or soil niches. Ceiling-mounted devices (such as refrigeration units) should be installed tight to the ceiling so no difficult top-of-unit cleaning is required.

**Refrigeration Units** Refrigeration units should be sized to cool product quickly and to maintain constant and correct temperatures for their particular application. All refrigerated areas should be equipped with temperature measurement and/or temperature recording devices. Installation of equipment-failure alarm systems should be considered, as well.

Evaporator drip pans in refrigerated rooms should be equipped with drain lines to remove condensate. Evaporator units (pans, fans, etc.) should be inspected regularly for dirt and mould formation and cleaned as required. Refrigeration and drainage lines should be constructed of corrosion-resistant materials (e.g., stainless steel or copper) to prevent physical contamination of loose material falling into ingredients or finished product. Pipe insulation should be kept in good repair for the same reason.

**Compressors** Air compressor units should be oil free to prevent cross-contamination of an oil odour and/or taste in food products. Potentially contaminating moisture may be removed with air dryers and/or traps. Traps and air filters should be cleaned and/or replaced regularly. Along with sampling room air, producers may also sample compressed air for contaminants including yeast and moulds.

**Containers** Containers, vehicles and other equipment used in the facility to transport raw materials, packaging materials and finished product should be kept clean and well maintained to reduce the potential for cross-contamination. To accomplish this, separate wash areas/rooms should be provided for cleaning raw materials handling containers and equipment, and for cleaning finished food product containers and equipment.

**Utensils** No wooden-handled utensils (e.g., brooms, brushes, squeegees) should be used in a food production facility. All must be constructed from food-grade materials to facilitate effective cleaning.

Clean-out-of-place (COP) tanks should be provided for cleaning small equipment parts and utensils. Clean utensils, small tools and protective apparel (e.g., aprons) used during food processing activities should be stored on non-toxic, non-reactive, non-absorbent, smooth, corrosion-resistant surfaces, shelving, hooks or racks (e.g., stainless steel or food-grade plastic).

Equipment, utensils, brushes and containers used for cleaning and sanitizing should be colour coded or labelled to identify their intended use and the area to which their use is restricted. All cleaning and sanitizing devices must be constructed of easily cleanable, non-absorbent (some natural fibres used in brushes can absorb, and later release, bacteria and viruses), non-toxic material. Following use, cleaning equipment should be stored grouped according to its intended use, separated from cleaning equipment with other intended uses, and away from food processing areas.

**Tools** Tools should be constructed from materials that are resistant to cracks and scratches (where microorganisms can grow) and are easy to clean. A documented system (e.g., a Standard Operating Practices or SOP) should be in place to describe how tools should be cleaned, who is responsible for cleaning them, how often they should be cleaned, and how and where they should be stored. Tools should be well maintained but replaced as soon as they become worn or are in poor condition.

**Detection Devices** To ensure protection of food products, installation of screens, magnets, metal detectors or other equipment is often necessary. Each must be located where it can provide maximum protection during processing. For example, the greatest benefit from a metal detector is achieved when it is positioned to check product as it enters its final packaging. All protective equipment must be properly maintained and calibrated.

Process monitoring and control devices should be plentiful and easy to read and interpret.

## Waste Containers and Utensils

**E4.2 Containers and utensils used for collection and holding of waste and inedible or hazardous substances are clearly identified, function properly, exhibit no signs of degradation that could led to the contamination of food, and can be cleaned and maintained. Containers and utensils are cleaned prior to entering food processing, handling or storage areas.**

Waste containers within the production facility used for collecting solid or inedible waste or hazardous material should be clearly identified for their intended use. If not clearly identified, there is risk of cross-contamination if food products are inadvertently placed in containers meant for non-food use. Colour coding can be an effective differentiation tool. Containers should be of adequate size for the amount of waste generated and fully covered with easy-opening lids that prevent accidental spillage and entry of pests.

Waste containers should be leak-proof, waterproof, and constructed of durable, easy-to-clean material. Leak-proof plastic or wet-strength liners may be used. Containers must be cleaned inside and out before being taken into food processing, handling or storage areas. Areas used for cleaning waste containers should be physically or operationally separated from production areas.

Waste should never move through food processing, handling or storage areas when there is risk of contamination or cross-contamination with food, ingredients and packaging. It must never pass over food processing lines. To avoid cross-contamination with employees and equipment, care must be taken not to spill waste while emptying containers.

## Handwashing Stations

**E4.3 An adequate number of conveniently located and readily accessible hand washing stations are provided in areas where exposed food, ingredients and packaging materials are processed or handled, and in washrooms and other locations necessary to prevent or minimize contamination. Hand washing stations are properly installed and maintained and are provided with warm potable water, soap, a hygienic drying apparatus and a cleanable waste receptacle.**

During production activities, employees' hands often become soiled. In addition to employee washrooms, the production area should be equipped with handwashing stations. Every facility should have a sufficient number of handwashing stations to allow employees to wash their hands without waiting. The number of stations will depend on the size of the production area and the number of employees. As a starting point, one handwashing station should be provided for every 75 sq. m of food production area.

Each station should be equipped with potable warm water, liquid soap in a pump dispenser, disposable paper towels and cleanable waste container. Paper towel dispensers should allow the paper towel to be pulled out without the freshly washed hands touching the dispenser. A hand sanitizer may also be provided. Ideally, tap operation should be "hands free" to prevent recontamination of hands. These facilities must be easily accessible, and access to them must not require travel through another processing area.

Handwashing stations must be kept clean so they do not become a source of contamination. They should never be used for purposes other than handwashing (e.g., washing utensils). Each should be equipped with a trapped drain.

Signs in appropriate languages should be installed to remind employees to wash and sanitize their hands before they begin work, after each absence from their workstation and any other time that their hands become soiled.

While it may sound simplistic, employees must be trained to wash their hands correctly. Section O1.2 discusses proper handwashing techniques in detail.

In some production facilities, boot-sanitizing baths may be installed at all entrances to processing areas. Sanitizing solutions must be changed often in order to retain an effective sanitizing level of 500 parts per million.

## E5 WATER SAFETY

**Adequate Supply and Protection of Water, Ice and Steam**

**E5.1 Potable water, ice and steam are supplied at volumes, pressures and temperatures necessary for all sanitation and operational activities. Appropriate facilities for water storage, treatment, distribution and temperature control are available to protect the safety and suitability of food.**

As noted earlier, potable water systems should be separate from non-potable water (e.g., wastewater, auxiliary lines such as sprinkler systems and sewage lines) and should be clearly identified (e.g., by colour coding or labelling).

All hoses and taps supplying potable water should be equipped with back-flow devices. When used as an extension of a water outlet, hoses and taps have the potential to siphon contaminated water back into the potable water supply if there is sufficient pressure difference.

For example: A garden hose is left running on the floor. A floor drain backs up so there is effluent on the floor. Just then, a large capacity water pipe in another section of the facility is turned on, significantly lowering pressure throughout the system and drawing water toward the large capacity pipe. As a result, effluent is siphoned into the water system through the hose lying on the floor, contaminating the water system.

To prevent this reverse flow (back-flow), back-flow devices (e.g., vacuum breaker or check valve) must be installed in **every** potable water outlet.

When not in use, hoses should be coiled neatly and stored so they do not impede floor drainage or trap waterborne contaminants. Storage should be on hangers where they will not contact ingredients, food contact surfaces, packaging materials or finished food products. Hoses should also be cleaned externally and internally (e.g., with a turbulent air/water mixture) on a regular schedule to remove dirt and microbial contaminants.

**Recirculated Water**

Recycled/recirculated water (including that used as wash water) must be confined to a clearly identified, separate system.

**Water Transportation /Storage**

Water/ice transportation and storage containers must be constructed of food-grade materials. Both must meet construction criteria outlined in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging*

*Materials and Non-Food Chemical Products*. It may be accessed at www.inspection.gc.ca/english/ppc/reference/u2e.shtml.

## O1 PERSONNEL PRACTICES

**Personal Hygiene/ Practices**

**O1.1 All personnel follow personal practices that prevent or minimize contamination of food, ingredients, packaging materials and food contact surfaces. Personnel do not eat, use tobacco, drink, chew gum, spit, sneeze or cough over food or food contact surfaces, or perform any other potentially hazardous activities in areas where food or packaging materials are being processed, handled or stored. Objects, such as jewellery, that may cause contamination are removed or are suitably covered prior to starting work duties. Personnel maintain an appropriate degree of personal cleanliness.**

People are the primary source of contamination in food processing plants. Contaminants can be transferred directly from the body, skin, mouth, hands, fingernails or hair to the food product during daily activities or can be transferred indirectly via food handlers' clothing or the utensils/equipment used.

Food handlers must maintain a high degree of personal cleanliness. The necessity of daily bathing and hair washing should be emphasized. Fingernails should be kept clean and trimmed. Reasonable amounts of deodorant or antiperspirants should be applied to protect against contamination by perspiration. However, the use of perfume or cologne should be avoided.

Use of skin and hair cosmetics (including false eyelashes, false fingernails and fingernail polish) or other substances applied to the skin or hair (including medicines and other chemicals) that may contaminate food, food contact surfaces or food packaging materials should not be permitted. Personal grooming (e.g., brushing hair or application of cosmetics) should be forbidden in food and ingredient handling areas.

Those engaged in food handling activities should make every effort to avoid contamination of food. For example, there should be no eating; drinking; sneezing or coughing over unprotected food; spitting; taking medication; use of tobacco, chewing gum or candy; or engaging in other unhygienic activities near food, food contact surfaces or food packaging materials. While they work, employees should also be encouraged to refrain from touching body surfaces including hair, nose, mouth and other areas where microorganisms are abundant. Those who do so should be encouraged to wash their hands immediately.

Everyone entering food handling areas should remove jewellery including earrings, rings, watches, pins, badges and other unsecured jewellery or any other objects that could fall into food, containers, or equipment or otherwise contaminate food. Hand jewellery that cannot be removed, such as plain wedding bands and MedicAlerts, should be fully and securely covered with materials that can be maintained in an intact, clean and sanitary condition that prevents food contamination. No personal effects of any sort should be allowed into food processing areas.

**SOP**

Each of these requirements that are appropriate to your operation should be included in a written Standard Operating Procedure (SOP). SOP preparation details are included in the "Control Programs" section. As a condition of employment, every employee should be required to agree, in writing, to comply with these standards.

## Handwashing

**O1.2 To prevent or minimize food contamination, effective handwashing is performed by all personnel who enter the food processing and handling areas or who handle food, ingredients, packaging materials or food contact surfaces. Handwashing is performed with warm, potable water, soap and hygienic drying apparatus upon entering food processing and handling areas; prior to handling food, ingredients, packaging materials or food contact surfaces; following breaks or use of toilet facilities; and when hands become contaminated.**

Handwashing is the single most effective method to reduce transmission of pathogens to food. Everyone who enters a food production facility must maintain hand hygiene to prevent microbial contamination of food products and food contact surfaces.

"Resident" and "transient" bacteria exist on the skin of normal, healthy people. Resident bacteria can be found in small folds of the skin, on hair and under fingernails. They are always there, cannot be completely removed and usually are not harmful. Transient bacteria are transferred to the skin by a variety of means during everyday activities (e.g., 10,000 microbes are transferred during a handshake). Because they are loosely attached to the surface of the skin, they can easily contaminate food products or food handling surfaces if food handlers do not wash their hands adequately. (There are 10 billion microorganisms in one gram of infected feces.) Hands can also become contaminated with viruses that can be similarly transferred. Transient microorganisms may be found on hands, fingertips and fingernails.

Almost all disease-causing microorganisms (bacteria, viruses, moulds, yeast and parasites) are transient. As few as 10 virulent microbes (e.g., *E.* coli O157:H7) may cause illness in vulnerable individuals (e.g., the very young, the old and those who are immuno-compromised). Pathogenic bacteria believed to be transmitted by food workers include *E. coli*, *Salmonella* spp., *Campylobacter*, *Shigella* spp., and *Clostridium perfringens*. Hepatitis A and noroviruses have also been identified as worker-transmitted causes of foodborne outbreaks.

Hand contamination may originate from a number of different sources. These include other hands and body surfaces, objects and environmental surfaces, clothes and fabrics, body secretions and excretions, equipment, water, food, soil and animals.

Hands must always be washed:

- Immediately before handling food, ingredients, packaging materials and/or touching food contact surfaces
- After using the toilet
- After coughing; sneezing; blowing or wiping the nose; touching ears, nose, eyes, mouth, hair, the face, or infected cuts, boils or pimples
- After each absence from the work station for coffee breaks and eating
- After handling incompatible food products, raw materials, potentially hazardous materials such as garbage or cleaning chemicals or touching non–food contact surfaces such as light or control switches
- After picking up objects off the floor
- Any other time hands become soiled or contaminated.

Studies show that hand hygiene consistently falls short of recommended standards. This may be due to an inadequate number of handwashing facilities, inconvenient/inaccessible location of handwashing facilities,

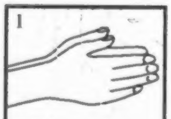
# Handwashing

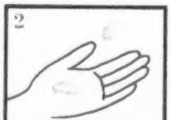
**To wash hands properly, rub all parts of the hands and wrists with soap and water or an alcohol-based hand sanitizer. Wash hands for at least 15 seconds or more. Pay special attention to the areas of the hand most frequently missed.**

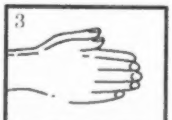
- **Keep nails short.**
- **Avoid wearing rings.**
- **Avoid artificial nails or nail varnish.**
- **Remove watches and bracelets.**
- **Wash wrists and forearms if they are likely to have been contaminated.**
- **Make sure that sleeves are rolled up and do not get wet during washing.**

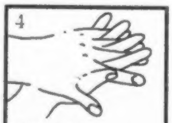
**If you have any questions regarding cuts, sores, allergies or pre-existing skin conditions, call Telehealth Ontario at 1-866-797-0000, TTY: 1-866-797-0007.**

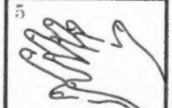
## Handwashing with soap and water

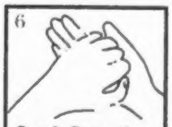
1

**Wet hands and wrists.**

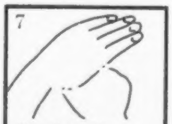
2

**Use a sufficient amount of soap.**

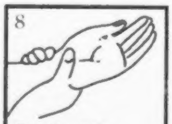
3

**Lather soap and scrub hands well, palm to palm.**

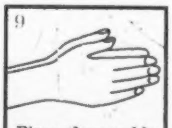
4

**Scrub in between and around fingers.**

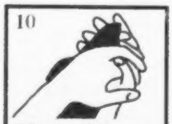
5

**Scrub back of each hand with palm of other hand.**

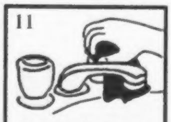
6

**Scrub fingertips of each hand in opposite palm.**

7

**Scrub each thumb clasped in opposite hand.**

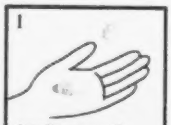
8

**Scrub each wrist clasped in opposite hand.**

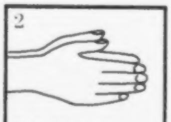
9

**Rinse thoroughly under running water.**

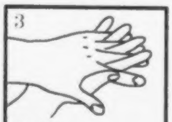
10

**Wipe and dry hands well with paper towel.**

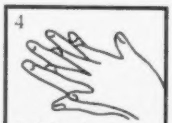
11

**Turn off water using paper towel.**

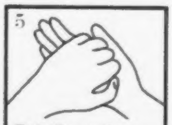
## Disinfecting with alcohol sanitizers

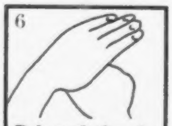
1

**Apply enough sanitizer to open palms.**

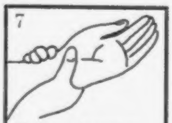
2

**Rub hands together, palm to palm.**

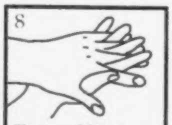
3

**Rub in between and around fingers.**

4

**Rub back of each hand with palm of other hand.**

5

**Rub fingertips of each hand in opposite palm.**

6

**Rub each thumb clasped in opposite hand.**

7

**Rub each wrist clasped in opposite hand.**

8

**Keep rubbing until hands are dry. Paper towels are not needed.**

Catalogue 7610-2137851 Nov/03 © Queen's Printer for Ontario, 2003

Ontario

insufficient time, lack of supplies (e.g., soap, towels), lack of adequate handwashing training or lack of supervision.

Proper handwashing technique may be summarized as follows:

- Remove hand jewellery. Millions of microorganisms can hide under rings, watches and bracelets.
- Roll up sleeves far enough so that wrists are exposed and sleeves do not get wet during washing.
- Wet hands and wrists under warm water (38°C to 43°C).
- Apply 3–5 ml of liquid soap. Plain detergent soaps physically remove soil and microbes. A list of acceptable hand cleaners/sanitizers may be found in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at www.inspection.gc.ca/english/ppc/reference/u2e.shtml.
- Lather soap and scrub hands well, palm to palm. Scrub in between and around fingers. Scrub back of each hand with palm of other hand. Scrub fingertips of each hand in opposite palm. Scrub each hand clasped in opposite hand. Scrub each wrist clasped in opposite hand. Alternatively, use a fingernail brush to produce lather on fingertips, hands and arms. In either instance, scrubbing must last for a minimum of 15 seconds to loosen transient microorganisms. (Sing one verse of *Happy Birthday* to yourself, slowly.) There is no need to loosen resident microorganisms by scrubbing for a longer period.
- Rinse hands and wrists thoroughly under warm running water of sufficient volume (8 L/minute suggested) to wash off the pathogens that have been loosened by handwashing.
- Dry hands well with a single-use paper towel. Transfer of bacteria and viruses occurs less frequently when hands are dry.
- To avoid recontamination, turn off water tap using the paper towel (if taps are not hands free). Alcohol-based sanitizers or protective hand creams can be used after handwashing. The same scrubbing actions used during handwashing should be used to apply alcohol sanitizers. Keep rubbing until hands are dry. Alcohol sanitizers are immediately effective against bacteria but have limited residual activity.

**Fingernail Brush** The U.S. Centers for Disease Control has documented that the bacterial population can be as high as 2 to 3 million *per fingernail*! These bacteria numbers can be reduced only by use of a nailbrush. Those that cannot be removed should be covered with gloves.

Some experts suggest that double handwashing is necessary before beginning the work day and immediately following use of the toilet. In this case, use of a nailbrush on fingertips and hand is followed by a thorough rinse then handwashing without a nail brush. While use of a fingernail brush is necessary to remove soil from under and around fingernails, excessive use should be avoided to prevent skin irritation. Irritated areas tend not to be washed as often or as effectively as necessary.

**Soap** Plain soap is adequate for removing transient microorganisms from the hands of food handlers whose hands will be covered with gloves. Antimicrobial soaps may not only destroy too many beneficial resident microorganisms, but also dry skin excessively. Alcohol preparations also eliminate both resident and transient microorganisms but are not a substitute for handwashing with soap.

However, if gloves are not being worn (not a recommended practice), the population of microorganisms on hands must be lowered to as low a level as possible. This may be accomplished by using antimicrobial soaps and/or using an alcohol-based preparation after washing.

**Hand Drying** The use of hot air dryers is generally not recommended. Dryers have been shown to increase levels of bacteria on hands because they accumulate and distribute toilet aerosols. Many handwashers do not have the patience to wait for their hands to be dried completely. As a result, clothing may be used as a towel. Damp hands are also conducive to microbial growth. (Studies show that 1,000 times as many germs spread from damp hands as from dry hands.)

Several studies have shown a significant reduction in bacterial counts when hands were dried with paper towels. The reduction was attributed to friction physically removing bacteria from hands. Used paper towels may also be used to shut off water taps in situations where foot pedal– or knee-operated taps are not available. Towels may also be used on door handles to avoid touching them with clean hands.

Where possible, paper towels should be provided from touchless dispensers. Do not use cloth towels, which can become a source of pathogen transfer to clean hands.

**Glove Use** Wearing gloves during food handling is widely accepted as an effective method of preventing the transfer of microorganisms from food handlers to food. However, gloves are effective only if they are part of a larger hand sanitation regime.

Hands must be clean and sanitary before gloves are put on. As noted earlier in this section, hands can become contaminated by touching body surfaces, secretions, and excretions, or from touching a number of environmental surfaces. If contaminated hands are not washed before donning gloves, the outer glove surface becomes contaminated during the act of putting them on and the inner surface becomes contaminated by contact with the dirty hands. Once on, gloves can be further contaminated by poor worker hygiene practices in the same way that hands are.

Microbial growth on hands is accelerated inside gloves, especially if hands are wet. Gloves with defects, those that leak, and those that are ripped or otherwise compromised expose these microorganisms to food, food contact surfaces and packaging materials. Therefore, poor quality gloves, gloves that have lost their integrity and disposable gloves that are being reused may cause more contamination than they prevent.

Whenever an employee leaves his or her workstation, or after he or she sneezes, coughs, touches hair or a non–food contact surface with the gloves, the gloves should be replaced. If gloves are torn or cut, gloves should be discarded, hands washed immediately and a new pair of gloves put on. To be effective, gloves must fit snugly but not so tightly that they are uncomfortable or tear. Shirt sleeves should be tucked inside glove cuffs when long sleeves are worn.

Different colour gloves should be designated for different tasks. Obvious colour differences will encourage food handlers to change gloves during task changes, which lessens the opportunity for cross-contamination.

Gloves are most often constructed of vinyl, latex or nitrile. Latex is flexible, less receptive to microbial contamination than vinyl and less likely to leak. However, latex gloves are not as easily washed, and some food handlers may exhibit an allergic reaction to latex. Vinyl is most economical for high-volume use. Nutrile gloves are tough, sensitive and durable but much more costly than vinyl or latex.

Once they have been removed, disposable plastic gloves must **not** be reused. Reusable gloves should be cleaned and sanitized between uses.

To avoid cross-contamination, colour-coded gloves should be confined to their designated areas. Gloves should not leave the assigned processing area and should ***never*** be taken into washrooms, lunchrooms or other areas of potential cross-contamination.

Whenever possible, clean, sanitized tools or utensils (instead of hands) should be used to handle food and ingredients. Of course, these instruments must be cleaned and sanitized between uses.

Although not always necessary, food handlers may use sanitizing hand-dips to minimize microbiological contamination on hands and/or gloves. When hand dips are used, stations should be located at every entrance and along employee traffic routes throughout the plant to encourage their use. Dip solution must be monitored regularly for chemical concentration (e.g., 200 ppm chlorine) and replaced frequently.

In order for hand hygiene programs to be successful, management must continuously train and educate new and existing employees on the importance of following good hand hygiene practices. A small number of periodic, random hand cleanliness verification checks can often improve the diligence with which everyone washes their hands. Laboratory plating of hand swabs will provide a visual image of handwashing effectiveness.

**SOP**

Each of these requirements appropriate to your operation should be included in a written Standard Operating Procedure (SOP). As a condition of employment, every employee should sign an agreement to comply with these standards.

### Clothing, Footwear and Headwear

**O1.3 Clothing, footwear and headwear worn by personnel and visitors in processing and handling areas prevent or minimize the contamination of food, ingredients, packaging materials and food contact surfaces. Clothing, footwear and headwear used in the establishment are stored and handled in a manner that prevents or minimizes contamination of food, ingredients, packaging materials and food contact surfaces.**

Contaminants can be transferred indirectly via employee's personal equipment such as clothing, footwear, utensils, tools and equipment (e.g., hoses, forklifts, pallet jacks, tape, pens) used during daily activities.

**Clothing** Ideally, the food processor should provide employees with protective outer clothing to create a barrier between body and product. This may include company-provided coats/smocks, impermeable plastic aprons, and/or sleeves, hairnets, beard covers and gloves.

Employees should begin each workday dressed in clean, sanitary, properly fitting clothing appropriate for the tasks being performed. Clothing should be close fitting with no loose, dangling or frayed material that could contact food, fall into food product or get caught in moving equipment. Metal zipper or snap closures that can be spotted by metal detectors are preferable to plastic buttons that cannot be detected. Clothing must not have pockets above the waist from which pens, pencils, notepads, tools and foreign material could fall. Existing above-the-waist pockets should be sewn shut. Long sleeves should be tucked inside glove cuffs to prevent potentially dangerous liquids from contacting the wearer's arms.

Protective clothing should be removed and stored in a sanitary area within the processing area before the employee enters a washroom, lunchroom or change room. This clothing must never be worn outside the building. When moving from "raw" areas to more sensitive product areas, protective clothing should be changed to prevent cross-contamination. Disposable garments are ideal for transient personnel such as maintenance workers or visitors.

When the employer supplies protective outer garments, colour coding may be used to distinguish workers in different processing operations. If they are easily identifiable by their clothing colour, employees will be discouraged from straying outside their assigned workstations. As noted in Section O1.7, colour coding workers will also discourage them from performing non-designated tasks. This further reduces opportunities for cross-contamination.

Laundering of protective clothing should be controlled by the processor to ensure adequate cleaning and sanitation. Garments must be able to withstand frequent washing and should be washed only in designated areas away from production and storage areas. Garments must not make contact with the floor during washing and sanitizing procedures. When clean, hang on well-ventilated racks so they can air-dry as quickly as possible.

**Footwear** Footwear can also transfer pathogens throughout the facility. Non-porous closed-toe footwear must be worn in food processing areas. The material must be cleanable. Leather or cloth does not meet either of these criteria. In addition, wet leather and cloth are uncomfortable so the wearer tends to avoid sanitizing foamers and foot dips. Pant legs should be worn outside boot tops to prevent potentially dangerous liquids from contacting the wearer's feet and legs.

The potential for cross-contamination can be greatly reduced or eliminated by either dedicating footwear to designated areas or decontaminating it each time the wearer moves to and from areas of higher or lower risk. When the decontaminating option is chosen, footwear must be cleaned and sanitized each time the employee travels from area to area. To facilitate this, footwear cleaning/sanitizing stations should be located in traffic areas where they cannot be avoided. Many plants provide footwear brushes, and/or disinfecting footbaths, floor foams, or boot water sprays at each interior and exterior door. Sanitizer concentrations should be routinely checked to ensure effective levels are maintained. This is especially true for foot dips where organic matter buildup can quickly destroy sanitizer effectiveness. Foot dips should be monitored frequently for concentration and volume and changed regularly.

Footwear worn in processing areas must not be worn outside the plant. At the end of each production shift, cleaners and brushes should be provided for footwear cleaning, as well as appropriate storage areas.

**Headwear** All employees handling food, food materials or food packaging materials must wear proper hair covering. Hair in food may be considered both a quality and food safety issue (for what might be on the hair). Hairnets must cover all hair, including sideburns, in order to prevent hair from contacting exposed food and clean and sanitized equipment, and to keep workers' hands out of their hair. Contrary to what some employees may believe, hairnets are a functional piece of clothing and must be worn correctly; they are not to be worn as a fashion statement. Similarly, all beard and mustache hair must be covered by beard restraints.

Mesh hairnets are most comfortable because they allow escape of body heat. However, for maximum protection, a very fine mesh must be used.

**SOP** Each of these requirements appropriate to your operation should be included in a written Standard Operating Procedure (SOP). As a condition of employment, every employee should be required to agree, in writing, to conform to these standards.

### Storage—Clothing, Equipment and Utensils

**O1.4 Clothing, utensils and equipment used in the establishment are stored and handled in a manner that prevents or minimizes contamination of food, ingredients, packaging materials and food contact surfaces.**

Personal belongings must be stored in lockers or designated employee areas separate from food processing and equipment/utensil washing areas. Individual, lockable lockers encourage this practice. Extra clothing, knapsacks, lunches, beverages or personal belongings must be strictly prohibited from the food processing area to avoid cross-contamination. Personal item storage areas (e.g., lockers) should be cleaned regularly and kept neat and tidy to promote a "clean" attitude among employees.

Cleaning brushes, other cleaning devices, utensils and protective clothing should be clearly marked (possibly colour coded) as to their specific use and area of use. Clean protective outer garments (e.g., aprons) and clean cleaning and sanitation staff garments (e.g., rain suits, rubber boots) and tools (e.g., brushes, brooms, etc.) should be stored in a sanitary environment where they will not become contaminated by processing or cleaning activities before their next use.

**SOP** Storage requirements should be the subject of a Standard Operating Procedure (SOP).

### Injuries and Wounds

**O1.5 Personnel having open cuts or wounds do not handle exposed food, ingredients, packaging materials or food contact surfaces unless measures are taken to prevent direct or indirect contamination of food. When injuries or wounds occur during food processing activities, measures are taken to ensure that suspect food, ingredients and packaging materials are disposed of and food contact surfaces are cleaned and sanitized.**

Employees should be instructed to report wounds/cuts incurred during their daily activities to their supervisor immediately. Aside from food safety issues, such reporting is also a Worker's Safety and Insurance Board (WSIB) regulation.

Employees with minor cuts or wounds, regardless of their source, should not handle food until the injury is completely covered by a secure, waterproof bandage. An impermeable cover must also cover boils or infected wounds or sores that are open or draining. On hands or wrists, that cover must be further covered by a disposable glove. Bandages and coverings should be changed frequently to prevent microbe-laden fluids from dripping onto food, food contact surfaces and food packaging materials. All bandages should be highly visible (e.g., brightly coloured) and identifiable by a metal detector so they are easily noticed should they end up in the food product.

A well-stocked first-aid station should be easily accessible so employees can treat and cover minor wounds before being cleared by their supervisor to return to food handling activities.

Should an injury result in contamination of food, food ingredients or packaging materials (with blood, skin, hair, etc.), all contaminated material must be immediately removed from the processing area and disposed of. Affected food contact surfaces must also be cleaned and sanitized before food processing resumes.

**SOP** The standards appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

**Evidence of Illness**

**O1.6 Personnel known or suspected to be suffering from or to be carriers of a disease transmissible through food do not enter any food processing or handling areas, or handle food, ingredients, packaging materials or food contact surfaces without taking measures to prevent contamination.**

A wide range of communicable disease and infections may be transmitted from infected food handlers to consumers through food. For example, unwashed hands of infected food handlers can introduce *Shigella* and *Salmonella* bacteria, Hepatitis A virus, and noroviruses to food.

Those infected with an infectious disease often begin to shed pathogens into their environment before they show symptoms of illness. They continue to shed pathogens while they are ill and for a period of time after they appear to have recovered. For this reason, food handlers showing symptoms of an active case of an infectious disease or diarrhea must be excluded from duties that involve direct or indirect contact with food, food contact surfaces or packaging materials.

Food handlers should be asked to disclose symptoms of diseases transmissible through food to their supervisor before beginning their workday. Because that may not always happen, supervisors should familiarize themselves with the symptoms of infectious diseases so those showing these symptoms can be excluded from food handling areas. (See chart below.) Frequent trips to the washroom may be the most obvious indication of illness.

| **Pathogen Transmitted by Food** | **Symptoms** |
|---|---|
| *Campylobacter* spp. | diarrhea, fever, abdominal pain, nausea, headache, muscle pain |
| *Salmonella* spp. | nausea, vomiting, abdominal cramps, diarrhea, fever, headache |
| *Shigella* spp. | abdominal pain, cramps, diarrhea, fever, vomiting |
| VTEC (verotoxogenic *E. coli)* | severe abdominal pain, bloody diarrhea, fever |
| *Yersinia* spp. | fever, abdominal pain, diarrhea |
| Hepatitis A | sudden fever, malaise, nausea |
| Noroviruses | nausea, vomiting, diarrhea, abdominal pain, fever |

Individuals with colds resulting in discharges from the nose, ears, or eyes, or who are coughing and sneezing, must not be allowed to work in food handling areas or near food contact surfaces or food packaging materials. The same rule applies to other contagious illnesses (e.g., the flu). Those with visibly infected skin, open sores, or other weeping wounds must not participate in food processing procedures unless the wounds are adequately covered (see Section O1.5 above). This policy should be posted in the work area and discussed with prospective employees at the time an offer of employment is made.

High–health risk candidates are not suitable for work in a food handling environment. Employers must adhere to all requirements of the Ontario Human Rights Code when advertising positions, preparing employment application forms and interviewing. *Hiring? A Human Rights Guide*, prepared by the Ontario Human Right Commission, may be accessed at www.ohrc.on.ca/english/publications/hiring-guide.shtml. The OHRC also publishes a *Policy on Employment-Related Medical Information* at www.ohrc.on.ca/english/publications/employment-medical-info-policy.shtml.

According to the OHRC, "requirements or duties for employment should be reasonable, genuine and genuinely related to performance of the job." At the job posting stage, mention of medical status "may unfairly prevent or discourage people from applying for a job." Application forms that ask medically related questions are considered discriminatory. Employment-related medical examinations or inquiries that are part of the applicant screening process are also not permitted.

At the interview stage, the employer may expand the scope of job-related questions to determine the applicant's qualifications or ability to perform the essential duties of the job. "The Commission recognizes the fact that it would be advantageous to both the employer and prospective job applicants if the employer were to disclose information on any specific medically related requirements of a position at an early stage of the recruitment process."

Health status issues should not be raised by the employer until after a conditional offer of employment is made. That conditional offer may include a signed verification by the prospective employee that he or she is free from communicable or infectious diseases that could negatively impact food safety. Another condition of employment should be that employees agree to immediately report injuries, wounds or illness to their supervisor. The consequence of non-compliance of these conditions of employment is termination of employment.

## Access and Traffic Patterns

**O1.7 Access of persons is controlled to prevent or minimize contamination of food, ingredients, packaging materials and food contact surfaces. Personnel follow designated traffic patterns to prevent or minimize contamination of food, ingredients, packaging materials and food contact surfaces.**

People, equipment, tools and utensils that travel from one processing area to another are potential sources of contamination.

**People** Seemingly harmless movement and actions of workers may result in contamination. For example, a knife from a worker's toolbox is carried into the production area by an outside maintenance contractor and laid on a food contact surface (potential microbial contamination). Or a knife is used to open a chemical sanitizer then, without proper cleaning, is used to open a food ingredient container (potential chemical contamination). Or a plastic cap of a pen used to complete records falls onto the fast-moving packing line and, because it is not metal, cannot be detected by the metal detector (physical contamination).

Traffic patterns should be clearly defined, marked and enforced. Food handlers should be restricted to the immediate area of their workstations. Access to their workstations should be as direct as possible, avoiding, if possible, travelling through areas of other processing or storage activities. Colour-coded uniforms, aprons or hairnets associates workers with their work area and discourages them from wandering outside their designated areas.

A discussion of traffic flow design may be found in Section E2.1.

Even within clearly defined areas, workers who handle both food and non-food products can be potential sources of contamination. To avoid this potential contamination, some facilities designate food product handlers and non-product handlers. Those designated as food handlers touch only food and food contact surfaces, nothing else. Designated non-product handlers pick up items off the floor and other non–food contact surfaces, and handle squeegees, hoses, pallets and other production tools, but never touch or handle food product. Colour-coded clothing differentiates between those who are allowed to touch food products and those who aren't.

**Equipment/Tools** Utensils, tools and equipment that move through the facility during production, maintenance and sanitation activities may also be a source of product contamination. For example, a forklift, leaking hydraulic oil (chemical contamination), routinely drives from an unpaved outside receiving area (physical contamination from dust) into the building where it drops off raw product at the start of the production line. On the way to pick up finished product, it carries out a bin of garbage, driving through a backed-up pool of effluent (potential microbial contamination) as it goes. It then drives past the production line to the packing area where it picks up finished product that it deposits in the cooler. In this somewhat exaggerated scenario, there are multiple opportunities for cross-contamination.

Understandably, maintenance personnel are often more concerned with the technical aspects of repair than with the food safety implications. Contractors and temporary employees may be even less food safety–minded. As well, maintenance staff and their tools are often highly mobile within a food processing facility. This combination can create serious cross-contamination issues.

In larger facilities, maintenance staff and their tools and protective clothing should be confined to specific production areas. In smaller facilities, where this is not feasible, dedicating tools and clothing to specific areas should be considered. As a minimum, all maintenance personnel should have GMP training in personal hygiene (e.g., handwashing, traffic patterns, hair coverings, protective garments, and eating/drinking/smoking) and sanitation practices.

Following completion of any maintenance/repair activity, there should be a reconciliation of tools, parts, gloves and other materials to ensure that nothing is inadvertently left behind to contaminate food, ingredients or packaging. An assessment of the need for cleaning and/or sanitation of the immediate area should be undertaken by an assigned individual.

Tools should always be cleaned and sanitized between repair or maintenance activities. The challenge here is to find cleaners and sanitizers that are effective without corroding the tools.

## Facility Access

To minimize the risk of accidental or deliberate contamination of food, ingredients, packaging materials and food contact surfaces, entry into the facility should be controlled during both working and non-working hours.

For workers, delivery personnel, outside maintenance workers, visitors, and others, access to the facility should be restricted to entrances that can be physically or electronically monitored. Many processing facilities require everyone, except plant employees, to sign in and out. Visitors must be identified with badges, dress according to visitor GMP policy and be accompanied by appropriate plant personnel while in food handling areas. To reduce the potential for contamination of finished products, plant tours should originate in product packing areas and end in receiving areas ("clean" to "dirty").

A security system, fencing, or other measures may be required to prevent entry of uninvited visitors who are intent on damaging and/or contaminating the facility or food products.

**SOP** Each of the above operational procedures that are appropriate to your operation should be included in a Standard Operating Procedure (SOP).

## Chemical Use

**O1.8 Chemicals are mixed in clean, correctly labelled containers, in the correct concentrations, and are dispensed and handled only by authorized and properly trained personnel. Chemicals are suitable for use within a food processing establishment and when used correctly do not present a food safety hazard.**

All chemicals used in a food processing establishment should be listed in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products*. The list may be accessed at www.inspection.gc.ca/english/ppc/reference/u2e.shtml.

An up-to-date list of stored chemicals and their storage location is highly recommended. Chemical storage areas should always be locked. One-person control of chemical accessibility will create accountability. This may take the form of a designated person in charge with another designated person as the backup. Only chemicals needed within the facility (e.g., cleaners and sanitizers) should be kept on-site.

As much as possible, all chemical products should be kept in their original containers with their original labels. Those that are not must be placed in clean, impermeable containers that are appropriate for the chemical. All containers must be distinctly marked/labelled as to their content. (For worker protection, a Workplace Hazardous Materials Information System [WHMIS] label should also be attached to each container.) All chemical containers should be tightly capped to prevent escape of contaminating odours and to prevent accidental spillage.

Chemicals should be mixed in clean, impermeable containers. These containers should also be clearly marked with the chemical and its concentration.

**Insecticides, rodenticides and other pesticides should be stored separately from cleaning and sanitizing chemicals. The importance of worker training in proper handling, mixing, applying and storing chemicals cannot be overemphasized.**

Grease guns should be labelled to indicate whether their lubricants are food grade or non–food grade. Forklift trucks, pallet jacks and other mobile equipment should be monitored for leaking fluids that are potential cross-contaminants.

### SOP

Each of the operational procedures discussed above that is appropriate to your operation should be included in a Standard Operating Procedure (SOP).

Although MSDS and WHMIS are outside the scope of food safety, a short discussion may be useful here. The law requires that employers ensure that controlled chemical products (as defined by the Hazardous Products Act) used, stored, handled or disposed of in the workplace are properly labelled; Material Safety Data Sheets (MSDS) are available to the workers; and workers receive education and training to ensure the safe storage, handling and use of controlled products in the workplace. Material Safety Data Sheets outline the hazards associated with that particular chemical, first aid measures, handling and storage requirements, personal protection precautions and toxicology. Employers may also wish to provide WHMIS training to those who are authorized to handle chemicals. WHMIS deals with the cautionary risk labelling, and precautionary measures and first aid measures (in words and universal symbols).

### Chemicals Used During Operations

**O1.9 Chemicals used during operations are handled and stored in a manner that prevents contamination of food, ingredients, packaging materials and food contact surfaces. Chemicals used during operations are in appropriately labelled containers or dispensers.**

Chemicals used in ingredient storage, food processing, packaging and shipping areas must be managed in a manner that minimizes the potential for contamination of food, ingredients, packaging materials and food contact surfaces.

Chemicals must be properly labelled to avoid misapplication. Chemical solutions must always be used at the concentration level and quantity most effective for the designated cleaning, sanitation or maintenance activity. Concentrations that are too low are ineffective. Too high concentrations risk chemical contamination of food, ingredients, packaging materials, and food contact surfaces, and waste financial resources. Always follow the manufacturer's recommended usage guidelines.

Chemical containers must be sealed tightly or properly covered when not in use to avoid accidental spillage. Once use of the chemical has been completed, the unused portion should be tightly capped and returned to a secure chemical storage area. During application of chemicals or chemical solutions, care must be exercised so chemicals are restricted to their intended area. For example, application of cleaners or sanitizers with pressure equipment may create aerosols or oversprays that can contaminate adjoining ingredient storage, food processing, packaging areas and shipping areas.

Poisons should never be brought into food storage, processing, packaging or shipping areas.

Use of excessive lubricant may result in food contamination. Excess lubricant must always be removed before food processing activities begin or resume.

**SOP** Each of these operational procedures appropriate to your operation should be included in a Standard Operating Procedure (SOP).

## O2 SHIPPING, RECEIVING, HANDLING and STORAGE

**Conveyance Vehicles**

**O2.1 Conveyance vehicles and containers used for transport of food, ingredients or packaging materials are suitable for the intended purpose and constructed to permit effective sanitation and pest control activities. Incoming and outgoing vehicles and containers are assessed before and during unloading and loading to ensure they are suitable for the intended purpose.**

Transportation vehicles and containers may contaminate food, ingredients and packaging materials. This can negate all prior efforts at minimizing contamination. Contamination may result from dust, mould or other extraneous material, from chemical residues remaining from previous loads, and from microorganisms due to poor sanitation conditions or cross-contamination with incompatible foods or materials in the same load. Vehicles used to transport food, ingredients or packaging materials should be used exclusively for that purpose. Vehicles used to transport glass or hazardous chemicals should never be used be used to transport food, ingredients or packaging materials. Regardless of the previous load, a routine trailer washing program should be undertaken between loads.

Before loading or unloading any vehicle transporting food, ingredients and packaging materials, it should be inspected for cleanliness (inside and outside), state of repair, and suitability for the food, ingredients or packaging materials being transported.

Vehicles used for short hauls are often of lower quality than are long-distance carriers, so extra attention to vehicle condition may be required. Special cleaning care must be exercised if raw meat, poultry or fish products have been transported prior to minimally processed foods. All are significant sources of foodborne pathogens.

To facilitate effective cleaning and sanitation, vehicles must be constructed of materials that are readily cleaned and/or sanitized. Surfaces should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. Materials that cannot be adequately cleaned and sanitized (e.g., wood) should be avoided. There should be no openings or cracks that will allow dust and dirt to enter or refrigerated air to escape. Refrigeration equipment (if required) should be in good working order, properly calibrated and equipped with an alarm device in the event of failure. Reefer roof-mounted interior air ducts should be clean and free of defects, and the floor channels should be clean and free of airflow-blocking debris.

Sometimes, vehicles that appear clean have disagreeable odours. These odours must be eliminated before loading takes place to avoid odour transfer to food, ingredients and packaging materials. Vehicles should also be dry and be free of condensation.

Ideally, before loading or unloading, the carrier should provide a log of previous loads, as well as proof of cleaning and sanitation procedures undertaken between loads (e.g., a wash ticket). Even then, good judgment is required as to whether the carrier condition is suitable for loading or unloading to be undertaken.

**SOP** Appropriate conveyance vehicle standards should be included in a written Standard Operating Procedure (SOP).

### Loading and Unloading Practices

**O2.2 Contents of conveyance vehicles and containers are loaded, arranged and unloaded in a manner that protects the safety and suitability of food.**

Under ideal circumstances, food, ingredients and packaging materials would be shipped only as full loads to reduce the possibility of cross-contamination and temperature incompatibility. However, this scenario is not always possible. When incompatible foods or ingredients are shipped together, steps must be taken to keep them effectively separated.

When loading or unloading vehicles, shippers should be aware of potential for cross-contamination from pallets, cartons, bins, and other food containers, as well as from forklift trucks. Unsanitary and/or unsound food containers can contribute physical (dirt, wood splinters, etc.), chemical (pesticide, cleaner or sanitizer residues) or microbial (*E. coli*, *Salmonella*, etc.) contamination. Their use should be avoided. Whenever possible, wood skids should be phased out and replaced by splinter-proof, more easily cleaned plastic skids. The same applies to wooden bins and containers.

Food, ingredients and packaging materials should be suitably protected and/or packaged prior to shipping. Received products should be similarly protected and free from damage upon arrival.

During loading, care must be taken to minimize damage to the shipment, shipment containers and the vehicle itself. Damaged goods should be removed from the shipment immediately, spills cleaned up, and the vehicle cleaned and sanitized, as necessary. Damage to the vehicle should also be repaired before the shipment is allowed to leave. Personnel involved in loading and unloading product should follow good hygiene practices. (See Sections O1.1, O1.2. O1.3, O1.5, and O1.6.)

Loads must be assembled in such a way that they will retain their integrity during transit. Containers should be stacked in an orderly way so they will not be crushed, broken or scattered during shipment. Various types of gates, braces, air bags, load bars and even empty skids may be used to maintain load integrity.

Resist the temptation to pack loads too tightly, especially if refrigeration is required. Always leave air channels, either down the centre or, preferably, along the sides of the load. Tightly packed loads make temperature maintenance difficult, especially when product has not been cooled properly before loading. Overfilling also blocks air circulation, resulting in uneven product temperatures.

Non-food items (e.g., chemicals) should be received at a different location than food, ingredients and packaging materials in order to prevent or minimize potential cross-contamination. Where this is not possible, they should be received independently from food, ingredients and packaging materials. After non-food materials are removed from the receiving area, any spills should be cleaned up, debris removed, and the area cleaned and sanitized as necessary before any food, ingredients and packaging materials are loaded or unloaded.

**SOP** Loading and unloading standards appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## Received Products

**O2.3 Incoming food, ingredients and packaging materials are assessed for evidence of food safety hazards and are controlled to protect their safety and suitability.**

Before receiving any incoming ingredients or packaging materials, make sure that they are from known suppliers and match those listed on the purchase order. Unexpected items may be a source of contamination.

As the vehicle doors are opened, note any off-odours. They could result from filth and/or infestation remaining from a previous load, product decomposition, or toxic solvents, petroleum products or chemicals carried with the load but unloaded at a previous stop. Also note the interior temperature. Odours or high temperatures in refrigerated loads could mean the products are unsafe. Such shipments should not be accepted.

**Damage** Broken, crushed, or otherwise damaged packages, cartons and similar containers may mean the product was exposed to insects, rodents, harmful chemicals, pesticides, or other contamination before it was loaded, or the shipment may have been improperly stacked or mishandled during loading. Taping over holes or repairing damage is an invitation to trouble. Also inspect for the presence of insects, rodent and bird droppings, and rodent urine. No matter the cause, damaged or soiled containers should not be accepted.

Liquid ingredients must also be protected from contamination. Transfer hoses must be clean, sanitary, and tightly capped and stored off the ground when not in use. Connection ports should also be kept clean and capped and locked when not in use. To prevent inadvertent connections to the wrong tank, hose connections are sometimes colour coded or distinctly different for different ingredients.

All incoming material should be received into an area separate from processing areas. Refrigerated products should be unloaded into a refrigerated dock area then moved quickly to the proper storage area.

Pallets travel from site to site and are subjected to all kinds of environments. Because their history is unknown, they should be examined for evidence of contamination (e.g., soil, fecal material, chemical stains) before unloading. Because of their porous nature, wooden pallets are higher risk than plastic. Visibly contaminated pallets should not be placed on the floor but either rejected or placed on easily washed plastic pallets.

**Specifications** Incoming food, ingredients and packaging materials should meet predetermined specifications/standards for food safety and quality.

Standards may include physical evidence (e.g., correct temperature; clean, intact, undamaged packaging; proper colour texture, odour and flavour; no indication of pest infestation, etc.); information supplied by the shipper (e.g., pesticide application records, inspection tags, temperature log, laboratory analysis, etc.); and results tests undertaken by the receiver (e.g., black/ultraviolet light scan for evidence of rodent urine, laboratory analysis of random samples, etc.). In the case of time-consuming laboratory tests undertaken by the receiver, until suitability has been determined, the product should be clearly identified and stored separately to reduce the risk of cross-contamination. Any product that fails to meet these predetermined specifications/standards should be rejected.

Some processors may require that growers/suppliers of fruits and vegetables provide documentation of adherence to Good Agricultural Practices (GAPs). In the case of ingredients or packaging materials, processor may ask for proof of adherence to GMPs or HACCP (an internationally recognized, science-based, food safety system designed to prevent, reduce or eliminate potential biological, chemical and physical food safety hazards).

**Chemicals** All non-food chemicals, including chemicals for cleaning and sanitation, pesticides, water treatment chemicals, paints, lubricants, etc., should be listed in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* (www.inspection.gc.ca/english/ppc/reference/u2e.shtml). If a damaged chemical product is accepted (e.g., leaking chlorine jug), the contents of that container must immediately be transferred to an appropriate container. The new container must be clearly marked as to its contents to ensure that it is used as intended. (A WHMIS label should also be attached for worker safety.)

**Codes** All arriving product should have an easy to decipher date code indicating the date of manufacture. Undated materials should be labelled with the delivery date or a use-before date. This will facilitate inventory rotation on a First In, First Out (FIFO) basis. Overstocking perishable commodities increases the opportunity for spoilage and contamination.

Records of received material should be kept, including product lot codes. Receiving records verify the adequacy of incoming material and control over food safety hazards. They also allow for traceability in the event of later food safety or quality issues.

Shipping and receiving personnel should be trained in correct receiving procedures and qualified to determine whether material being shipped and received meets established specifications/standards for food safety and quality. Shipping and receiving personnel should also adhere to good hygiene and sanitation practices. *(See Sections O1.1, O1.2. O1.3, O1.5* and O1.6).

**SOP** Receiving standards appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## Shipping Conditions

**O2.4 Food, ingredients and packaging materials are protected from contamination, damage and spoilage during shipping.**

The oldest product should always be shipped first. Lot and/or date coding greatly increases the ability to identify product and the probability of this happening. Product coding is discussed in Section O6.

**Refrigeration** Products requiring refrigeration should be precooled to the correct transport temperature before loading begins. If possible, food, ingredients and packaging materials should be staged for loading in an enclosed, temperature-controlled dock area. Staging time, especially for refrigerated products, should be as minimal as possible.

Refrigerated vehicles should be precooled before loading begins. Padded door seals on the loading dock help prevent air leakage into the dock and keep airborne dust and insects outside. Dock loading doors and vehicle doors should not be opened until the vehicle is tight against the enclosed loading dock. Food, ingredients and packaging materials must *never* be transported in open-bed vehicles.

Before loading goods that require refrigeration, the temperature of the vehicle's load compartment should be checked to ensure that it is appropriate to control growth of pathogenic or spoilage microorganisms. All temperature-controlled vehicles should also be equipped with temperature measuring devices and, preferably, a temperature recorder and a warning device. Refrigeration units without recorders and warning devices should be monitored regularly during transport. All temperature readings should be recorded.

Refrigerated vehicles making multiple deliveries should be equipped with a plastic ribbon curtain inside the rear door. This, and unloading as expeditiously as possible, will retain as much cool air as possible when the door is opened. Unnecessary transport delays should also be avoided.

**Personnel Hygiene** Truck drivers, inspectors, buyers and other food handling visitors to the shipping/receiving area must comply with the same good hygiene and sanitation practices expected of shipping and receiving personnel.

**Resources** The Canadian Produce Marketing Association outlines recommended transit conditions (temperature, humidity, ethylene producers, ethylene sensitivity and odour sensitivity) in its *Produce Shipments & Load Compatibility Chart* at www.cpma.ca/Trade/en/shipmentsload.asp. The USDA Agricultural Handbook Number 668, *Tropical Products Transport Handbook* (www.ams.usda.gov/tmd/Tropical/requirements.htm) offers a listing of fruit and vegetable transit and storage temperatures and relative humidity requirements in addition to a number of transportation recommendations. An article from the University of California, Davis, at www.thepacker.com/rbcs/handbookarticles/properis.htm, also discusses storage and transport of fresh produce.

**SOP** Shipping procedures appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## Returned and Defective Food Products

**O2.5 Returned, defective or suspect food, ingredients and packaging materials are clearly identified, stored and controlled for food safety assessment and disposition.**

Received products that have been rejected because they did not meet specifications/standards for food safety and quality should be immediately returned to the supplier. When this is not possible, to avoid contamination of other products, the rejected product should be clearly marked and segregated from accepted product until its return to the manufacturer.

The same regime should be followed for returned, defective or suspect product. It too must be clearly identified and stored in a controlled area isolated from "good" product while it awaits a food safety assessment or disposition (e.g., rework, repackage or disposal). Storage conditions should discourage further microbial growth or additional chemical or physical contamination.

**SOP** Rejected product handling procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

Although not a food safety issue, product disposal should be environmentally friendly and meet the requirements of all laws and regulations. Contact the Ministry of the Environment for advice, if necessary.

## Allergen Control

**O2.6 The presence of undeclared allergens in food products is prevented through control of the handling, storage and use of allergenic products and the equipment used in their processing. Rework of product(s) containing allergens is controlled. Procedures are in place to ensure that ingredient declarations list any allergens contained in the product.**

The scientific community estimates that food allergies affect approximately 1 million Canadians (3.3 per cent of the population). In the United States, it is estimated that 2.0 to 2.5 per cent of the population has a food allergy. However, a study released by the American Academy of Allergy, Asthma and Immunology estimates that approximately 1 in 25 Americans (4.0 per cent) is affected by one or more food allergies. Regardless of the actual number, allergens have become a serious food issue during the past few years.

The basic cause of food allergies is the reaction of the immune system of sensitive individuals to some component of a food, usually a protein. Their bodies decide that the particular food is harmful and create antibodies to protect the body. When an individual next consumes this particular food, the immune system releases massive amounts of chemicals that trigger allergic symptoms.

**Allergens** Peanuts, tree nuts, cow's milk, eggs, soybeans, finfish, shellfish, and wheat cause more than 90 per cent of food allergies. Sulfites and sesame seeds may also cause allergic reactions. Symptoms may include swelling of the lips, stomach cramps, vomiting, diarrhea, hives, rashes, eczema, wheezing or breathing problems. The most severe reaction can cause death in 10 to

15 minutes. Canadian labelling law requires final product listing of the 10 potential allergen-causing ingredients noted above.

Processors should require full ingredient lists from raw material suppliers including those ingredients present in product sub-components such as flavours or processing aids. Using this information, a master list of allergens should be developed. Allergens should be identified as such in formulation recipes and their presence noted in production records.

Ingredients and products that contain allergens should be stored in areas designated strictly for that purpose, segregated from non-allergens and non-like allergens. Each allergen should have a dedicated storage area or bin, dedicated dispensing utensil, and dedicated weigh container. Colour-coded containers or tags can make identification of allergen-containing ingredients, bins and utensils easier.

## Control Measures

Changeover procedures from allergens to non-allergens or vice versa should be described in a Standard Operating Procedure (SOP), monitored to ensure compliance and documented. Production scheduling can include longer production runs that minimize changeovers. Products containing allergens can be scheduled last in a production cycle to minimize the possibility of cross-contamination. Adding the allergenic ingredient into the production process as late as possible decreases equipment exposure time, as well as shortening the time for cross-contamination.

Meticulous cleaning and sanitizing of equipment between allergen-containing product processing and non-allergen product processing can control the presence of allergens. Changeover cleaning must include ***all*** equipment and utensils, as well as removal of allergenic waste from the facility. A Sanitation Standard Operating Procedure (SSOP) should describe the cleaning and sanitation procedure. Visual inspection and/or test kits that indicate the presence of some allergen residues should be used to determine the effectiveness of cleaning. Records of changeover activities, including verification of the absence of allergen residues, should be maintained.

Tight controls must also be in place to ensure that allergen-containing products are packaged only in properly labelled containers. Periodically, label reconciliation should be conducted to ensure that the label accurately reflects the presence of allergens. Labels that do not accurately reflect product content must be destroyed. If there is any doubt as to potential allergen content in a finished product, that product should be labelled "may contain _______."

Ultimately, employee training and awareness are the best defence against unintentional allergen additions.

Allergen control procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

## Packaging

### O2.7 Package design and materials protect the safety and sanitation of food and accommodate proper labelling.

From a food safety standpoint, packaging must be non-toxic; block entry of biological, chemical and physical contaminants; be compatible with the food it will contain; protect against physical damage; and accommodate proper labelling. In addition to the food safety aspects, packaging assists quality by acting as a barrier to moisture loss or gain, providing a barrier to oxygen, and not allowing product leakage or loss.

Normally, minimally processed fruits and vegetables do not contain any preservatives and have not gone through any heat or chemical treatment. Typical packaging may be a plastic overwrap (e.g., bag or clam) or open container (e.g., basket). In some instances, modified atmosphere packaging (MAP) is used. In its most simple form, MAP may be a breathable plastic bag that allows the exchange of gases and moisture to produce the optimal storage environment to slow product deterioration (senescence) and to maximize protection from food safety contaminants. In some cases, an atmosphere high in carbon dioxide or nitrogen and low in oxygen replaces air, either by oxygen depletion through normal respiration (passive modification) or by removal of oxygen and replacement with carbon dioxide or nitrogen (active modification). Replacement gases must be non-toxic and, as with the packaging itself, not create undesirable flavours or odours.

Because low temperatures influence the effects of humidity and gas concentrations, low storage temperature is essential to the success of modified atmosphere packaging. The combination of a properly designed MAP and low-temperature storage delays spoilage of fresh fruits and vegetables and slows most pathogen growth (*Listeria monocytogenes* and *Yersinia enterocolitica* being two exceptions). Generally, minimally processed vegetables respond much more favourably to the use of MAP than do fresh-cut fruits.

New, single-use boxes and bags should be the first choice as containers, especially for microbiologically sensitive products. Often, they are required by regulation. In certain instances, containers may be reused if they are cleaned and sanitized or if new protective liners are used. Waxed boxes cannot be reused. All surfaces that contact food (e.g., plastic box liners) should be manufactured from food-grade materials to reduce the risk of contamination. A list of approved packaging materials and their manufacturers may be found at the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* website (www.inspection.gc.ca/english/ppc/reference/u2e.shtml).

The use of staples, which can damage and contaminate packaging materials and food, should be avoided. When glass is used as a packaging material, a written Standard Operating Procedure (SOP) for glass control in the event of breakage should be in place.

Bulk containers (e.g., bins, boxes, totes, etc.) should be designed and constructed so they do not contaminate either food or packaging and can be effectively cleaned and/or sanitized. Surfaces should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant, food-grade materials that are able to withstand repeated cleaning and sanitizing.

Labelling must meet regulations of the Consumer Packaging and Labelling Act (http://laws.justice.gc.ca/en/C-38/index.html), as well as those of the Food and Drugs Act (http://laws.justice.gc.ca/en/F-27/index.html) and the 2003 Guide to Food Labelling and Advertising (www.inspection.gc.ca/english/fssa/labeti/guide/ch1e.shtml).

**SOP** Packaging standards appropriate to your product(s) should be included in a written Standard Operating Procedure (SOP).

## Storage Practices

**O2.8 Food, ingredients and packaging materials are processed, handled and stored in conditions that protect their safety and suitability. Food, ingredients and packaging materials are rotated to protect their safety and suitability.**

### Separation

Storage areas should be separated from other activities. Whenever possible, different personnel and equipment should handle tasks exclusively in the separated areas to reduce the potential of cross-contamination. When this is not possible, food handlers should change outer clothing/footwear when moving from "raw" into "sensitive" areas.

Raw products, ingredients (including compounded ingredients), finished products (including reworked products), and chemicals used during processing (e.g., sulfur dioxide) containing allergen-causing ingredients (peanuts, tree nuts, cow's milk, eggs, soybeans, finfish, shellfish, wheat, sulfites and sesame seeds) should be physically separated from other ingredients and food products to prevent cross-contamination. If allergens are stored in bulk bins, dedicated dispensing utensils and weighing devices should also be used. Everything must be clearly and accurately labelled.

### Hygiene

Storage areas must be kept clean and free of garbage and other debris. Spills should be cleaned up promptly. There should be regular monitoring for telltale signs of rodents and other pests such as insects and birds. When cleaning and repair/maintenance activities are undertaken, food, ingredients, and packaging materials should be covered to reduce the potential for airborne microbial and/or chemical contamination.

Soiled or broken pallets should not be used in storage areas or to transport ingredients or finished product. Where possible, wood pallets should be replaced with plastic, which is more easily cleaned and will not contribute physical debris. Empty pallets should not be stored in close proximity to raw materials or in food processing or food storage areas where they may provide harbourage for pests.

Personnel involved in moving food, ingredients and packaging materials should practise good hygiene and sanitation practices. Minimize physical damage and subsequent opportunities for contamination by exercising care when moving and storing food, ingredients and packaging materials. Clean up spills immediately and sanitize as necessary. Ideally, all materials should be stored 15 cm above the floor and at least 45 cm away from walls.

There should be a separation of at least 35 cm between pallets. This space will permit improved airflow (allowing faster temperature reduction in coolers), discourage pest harbourage, allow easier pest monitoring and permit routine cleaning.

**Temperature and Humidity**

Temperature and humidity heavily influence the safety and quality of minimally processed fruits and vegetables. Temperature and humidity must be monitored and maintained at levels appropriate to the stored food, ingredients and packaging materials. (For a list of storage temperatures and humidities for a number of fruits and vegetables, access the USDA's Agricultural Handbook Number 66, *The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stock* at www.ba.ars.usda.gov/hb66/contents.htm.) Temperature affects the respiration rate of fruits and vegetables, which, in turn, affects perishability. Depending upon the fruit or vegetable, respiration rates increase from two to four times with each 10°C rise in temperature between 0° and 50°C. Temperature also influences the rate of water loss, the rate of oxygen consumption, and the rate of production of carbon dioxide and ethylene. Care must be taken to ensure that chilling injury does not result from too cold temperatures.

Minimize delays before cooling. Cooling delays allow respiration and metabolism to continue at high rates, encourage water loss, and, most importantly, increase decay development—decay that may not be apparent for several days. Refrigerated areas should always be precooled before use to speed the cooling process. Product should always be cooled to its optimum storage temperature before being transported.

**Stacking**

Allow space between containers, use well-vented containers, and stack containers in such a way that air flows past each. Do not overfill storage areas, especially where refrigeration is required. Tightly packed storage makes temperature control and ventilation difficult, especially where quick temperature reductions are required.

Arrange stored food, ingredients and packaging materials in a manner that will facilitate proper stock rotation. Clearly labelling and dating incoming and completed product will help a First In, First Out (FIFO) system reduce the possibility of contamination through spoilage caused by too long storage. Slow product movement, caused by overstocking, also increases the opportunity for spoilage and contamination.

**SOP** Storage procedures appropriate to your product(s) should be included in a written Standard Operating Procedure (SOP).

## Chemical Storage

**O2.9 Non-ingredient chemicals and hazardous substances are stored securely and separately from food, ingredients, packaging materials and food contact surfaces. Potentially hazardous ingredients are stored in a controlled manner that ensures the safety and suitability of food.**

Except while in use, all chemicals (e.g., pesticides, herbicides, cleaners, sanitizers, lubricants, etc.) should be stored in designated locations well segregated from food, ingredients, packaging materials and food contact surfaces to reduce the potential for cross-contamination. Chemical storage areas should be locked. Metering controls and emptying devices on bulk chemical containers/tanks should also be locked when not in use.

Only trained, authorized personnel should have access to chemicals and chemical storage areas. A chemical sign-out and sign-in system along with an up-to-date inventory will assist in chemical accountability if more than one person has access. FIFO inventory rotation should also be practised.

The chemical storage area should be fully enclosed, clean, sanitary and dry. Adequate ventilation should be employed to ensure proper temperature and humidity levels. For the safety of all, incompatible chemicals should be kept separate from each other, stored in appropriate containers, tightly capped and correctly labelled (including a WHMIS label).

Only chemicals listed on the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* should be used. The list may be accessed at www.inspection.gc.ca/english/ppc/reference/u2e.shtml.
Chemical storage procedures appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## Waste Management

**O2.10 Waste is handled, stored and removed in a manner that protects the safety and suitability of food.**

Garbage attracts pests and can develop objectionable odours that can contaminate food, ingredients and packaging materials.

**Solid Waste** Garbage inside the building should be stored in clearly identified (colour-coded), covered, leak-proof containers that are of adequate size to hold at least one day's garbage. Overflowing, leaking and uncovered waste containers are a potential source of contamination. Interior containers should be emptied daily (or more often, if necessary) into covered exterior containers that are far enough away from buildings to discourage rodent travel.

To avoid cross-contamination with employees and equipment, care must be taken not to spill waste while emptying containers. Waste must never move through food processing, handling or storage areas when there is risk of contamination or cross-contamination with food, ingredients and packaging. If liners are not used in interior garbage containers, the containers should be washed after every emptying to remove odours and extraneous debris.

Exterior waste disposal containers must not leak, should always be covered and should be located far enough away from the production facility to discourage rodent travel. Exterior garbage containers should be emptied regularly (minimum weekly) so as not to attractive to pests.

**Inedible Waste** This organic waste results from sorting, trimming, coring, processing activities, etc. It should be kept separate from edible food products, ingredients, packaging materials and garbage in clearly identified (colour-coded), leakproof containers.

Containers should be placed in locations close to the waste source but not in personnel or equipment traffic routes where cross-contamination is possible. They should be of adequate capacity to handle the inedible waste generated and should be emptied before overflowing or decay begins. This will prevent odours, discourage pests and reduce opportunities for cross-contamination. As with garbage, this waste should not be transported through food processing, handling or storage areas when there is risk of contamination or cross-contamination with food, ingredients and packaging. Containers should be cleaned (and sanitized, if necessary) after each use.

Exterior containers of inedible waste should not leak, should be covered (when feasible) and should be emptied regularly to discourage pests. Dispose of organic waste in an environmentally friendly manner. A protocol exists between the Ministry of the Environment (MOE) and OMAFRA regarding disposal of ***agricultural*** waste on agricultural properties. Check with the MOE before using this method of disposal. Commercial haulers and composting sites, licensed by the MOE, may also be used for the disposal of inedible food products.

**Liquid Waste** As described in Section E3.5, sewage and wastewater should be handled by separate disposal systems designed to prevent contamination and cross-contamination of food, ingredients and packaging materials. In some instances, wastewater may be transported from the site by MOE–licensed vehicles to MOE–licensed treatment plants. On-site effluent lagoons or other treatment options may sometimes be employed for wastewater if approved by the MOE. Regardless of the disposal system used, it must not create conditions conducive to cross-contamination (e.g., odours) or attract pests.

**SOP** Waste management procedures appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## O3 SANITATION

**Cleaning and Sanitizing**

### O3.1 Cleaning and sanitation procedures are being performed in a way that protects the safety and suitability of food.

Food processing environments that are not adequately cleaned and sanitized can be a source of microorganisms that cause food spoilage and foodborne illness. These microorganisms may be bacteria, moulds, yeast, viruses or parasites.

When nutrients and moisture are available and when the environment is favourable (suitable pH, temperature and oxygen level), bacteria, moulds and yeast multiply in food. Viruses and parasites survive in food but depend upon a living host (e.g., the human body) to grow and reproduce.

Food spoilage microorganisms reduce shelf life by causing changes in food colour, texture, flavour and/or smell. These changes make the food undesirable or unsuitable for human consumption. Pathogenic microorganisms, which may produce illnesses or illness-causing toxins, do not create any visible changes in food.

Unclean food processing surfaces provide an ideal environment for the growth of microorganisms. When food comes in contact with unclean surfaces, food spoilage or pathogenic microorganisms can be transferred to the food being processed. This transfer of microorganisms from a contaminated source to a non-contaminated source is called cross-contamination.

Proper cleaning and sanitation of equipment, work surfaces and utensils will:

- Remove dirt and/or food material that harbour microorganisms
- Eliminate most bacteria, including pathogens
- Prevent cross-contamination
- Extend shelf life
- Improve food safety
- Increase protection against financial losses.

While the terms are often used interchangeably, **cleaning and sanitation perform entirely different purposes.**

**What's the Difference?** **Cleaning** is the removal of unwanted material (commonly called soils) from production equipment and production areas. Removing leftover particles eliminates many microbes, their food source and other physical debris that can contaminate future batches of food. Appropriate cleaning chemicals may be applied manually or mechanically to equipment that remains assembled (clean-in-place) or that is partially or fully disassembled (clean-out-of-place). Most often, a combination of methods is used.

**Sanitizing** is treatment of a cleaned surface with a chemical or physical agent (e.g., heat) to reduce disease and/or spoilage-causing microorganisms to levels considered safe for public health. By definition of the Association of Official Analytical Chemists, sanitizing a food contact surface must reduce the contamination level of specific bacteria (*E. coli* and *Staphylococcus* are the standard test organisms) by 99.999 per cent (a 5 log[1] kill) in 30 seconds. Non–food contact surfaces require a contamination reduction of 99.9 per cent (a 3 log kill), also within 30 seconds. When microbial populations are reduced to these levels, the surfaces are considered to be microbiologically clean.

It should be noted that even at three or five log reduction levels, sanitizers do not destroy all pathogens. For example, if there are 1 million bacteria per square centimetre, a 5 log reduction will reduce that number 99.999 per cent so 10 bacteria per square centimetre remain. Some of these may be pathogens or spoilage-causing organisms. Under favourable growing conditions (e.g., food, water, nutrients, and suitable pH, temperature and oxygen level), the population of the surviving bacteria may double every 20 minutes. Other bacteria (again including pathogens) may be partially inactivated by sanitizers but regenerate and become viable again. Therefore, surfaces that are "clean" immediately after cleaning and sanitizing operations may develop high bacterial levels if left undisturbed for a period of time (e.g., overnight). As a general rule, surfaces left for more than four hours must be sanitized again before production begins.

Undesirable microorganisms (pathogens and/or spoilage-causing organisms) may come from:

- Ingredients (e.g., fruits and vegetables to be processed or packed)

---

[1] The term "log" is an abbreviation for logarithm. A logarithm is a "power of 10" ($10^1$). Each logarithmic (log) reduction reduces the microbial population by 90 per cent.

- People (e.g., dirty hands)
- The building (e.g., dirt and condensation dripping from overhead pipes, dirty drains or unclean doorknobs)
- Equipment (e.g., packaging equipment, pallet trucks travelling through the building, dirty buttons and switches, or dirty cleaning brushes)
- Improperly stored trash and product residues
- Non-potable water
- Pools of water on the floor
- Rodents and other pests
- The air (via aerosols)
- Many other sources.

**Biofilm** Incomplete cleaning/sanitation encourages development of biofilm, which becomes an ongoing source of bacterial contamination from apparently clean surfaces. Both pathogenic and spoilage microbes can form biofilm.

A biofilm is a microcolony of bacteria that securely attaches itself to an inert surface using complex polysaccharide-like material. Once formed, a biofilm provides bacteria with an environment that is favourable to their survival while protecting them from flows of liquids, changes in pH or temperature, and chemical cleaners and sanitizers. Both pathogenic and spoilage microbes can form biofilm.

Biofilm can form on the surface of hoppers, conveyors, mixers, grinders, fillers or any other surface that is in continuous contact with food. The microcavities of porous surfaces such as elbows, junctions, cracks and splits are also ideal areas for accumulation of residues and biofilm-forming bacteria.

Once in place, biofilm is extremely difficult to remove or sanitize. Removal often requires sophisticated cleaners with oxidizing agents. The best defence against biofilm development is prompt, regular, complete cleaning and sanitation of all food production surfaces.

As noted earlier in Section O1.8, a list of acceptable cleaners and sanitizers can be found on the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at www.inspection.gc.ca/english/ppc/reference/dppe.shtml. Only these chemicals should be used. If in doubt, contact the nearest CFIA office to confirm approval of specific chemicals.

## Cleaner Selection

The choice of cleaning chemicals is determined by:

- The type and/or combination of types of unwanted matter (soils)
- The composition and area of the surface to be cleaned
- The method of cleaner application
- Characteristics of the water used.

### Soils

Residual soils in food processing facilities may generally be classified as organic (derived from living organisms) or inorganic (non-living thing). Generally, only organic soils will be encountered in foods of plant origin production.

Some organic soils (e.g., sugars, some starches, and most salts) are soluble in water, while others (e.g., protein, fat and oil) are soluble in an alkali. Alkaline chemicals (detergents) are best for removing carbon-based organic soil loads (e.g., food wastes). For protein soils, a chlorinated alkaline detergent is most effective. When chlorine is added to an alkaline detergent, it enhances the cleaning effect of the detergent but does not act as a sanitizer.

Moderately alkaline or neutral cleaners are used to remove organic soils. For specific applications, alkaline cleaners are commonly blended with other chemical agents to dissolve, suspend and disperse soils. Typically, these cleaning agents consist of an alkaline cleaner, surfactants and chelating agents.

Moderately alkaline cleaners include disodium carbonate, sodium metasilicate, and tri-sodium phosphate (TSP). Carbonate-based detergents have limited use in food processing plants because they interact with calcium and magnesium to form highly insoluble compounds. Silicates are most often included in cleaners as a corrosion inhibitor. TSP has a long history of effectiveness against organic soils. Water conditioners, corrosion inhibitors, and wetting or emulsifying agents may also be formulated into cleaners.

Highly alkaline detergents (e.g., caustic soda or sodium hydroxide, caustic potash or potassium hydroxide) are used in many circulating clean-in-place

(CIP) systems. Acid detergents include organic and inorganic acids and are most frequently used in beer or milk bottling operations. Enzyme-based detergents are limited to use on unheated surfaces.

Inorganic soils (e.g., hard water scale and most mineral deposits) are soluble in acid chemicals.

Some soils are soluble in water, alkali or acid. Often soils contain mixtures of several components. This further complicates cleaner/sanitizer selection. Biofilms require sophisticated cleaners with oxidizing agents.

Food Soil Characteristics

| Soil Type | Solubility | Ease of Removal |
|---|---|---|
| Starch | Water, Alkali | Easy to Moderately Easy |
| Sugar | Water | Easy |
| Fats/Oils | Alkali | Difficult |
| Protein | Alkali | Very Difficult |

Fresh soils are more easily dissolved than are old, dried-on deposits. Using too hot water or improper cleaners can "set" soils, making them more difficult to remove. Applying the proper cleaner will ease soil removal.

**Surfaces** Surface composition alters the effectiveness of different cleaning and sanitizing chemicals. Although 300 series stainless steel or food-grade plastic are the recommended surfaces for food production, other surfaces are sometimes used.

300 series stainless steel is corrosion resistant, durable and easy to clean. However, prolonged use of strong acidic cleaners in combination with chlorine may damage stainless steel. 400 series stainless steel is more prone to corrosion than is 300 series.

Food-grade plastics are also smooth and impervious. However, effective cleaning may become difficult if the surface becomes scratched, pitted or scored. Pitted, cracked, corroded, or rough surfaces may reach a point at which they can no longer be effectively cleaned or sanitized. When this occurs, these surfaces should be replaced.

Wood is easily damaged, creating cracks and crevices that harbour microorganisms. Wood should be cleaned with an abrasive cleaner and sanitized well. The use of wood is **not** recommended in food processing facilities.

Iron-based alloys (e.g., carbon steel) are prone to rusting. Acidic cleaning compounds encourage rust formation, as do chlorine sanitizers. Only neutral cleaners should be used on iron-based or galvanized surfaces. Tin surfaces are sometimes an alloy of tin and lead so their use is not recommended because exposure to lead is known to have adverse effects on human health.

Painted surfaces have different characteristics depending upon the paint used. **OMAFRA does not recommend painting food contact surfaces.** Regardless of the surface painted, only paint acceptable to the Canadian Food Inspection Agency (CFIA) should be used. A list may be found at www.inspection.gc.ca/english/ppc/reference/cone.shtml#d.

### Surfaces and Cleaner Summary

| | |
|---|---|
| Stainless steel | Use non-abrasive acidic and alkaline cleaners; do not use hydrochloric acid or chlorides; corrosive properties of stainless steel vary with grade |
| Plastic | More corrosion resistant than stainless steel; resistant to chlorine; may crack or cloud from prolonged exposure to strong acidic or alkaline cleaners; easily scratched |
| Nylon | Do not use acidic cleaners |
| Rubber | Deteriorates with constant use of chlorine; use alkaline cleaners |
| Brass, copper, mild steel | All less corrosion resistant than stainless steel; acidic cleaners encourage steel rusting; use moderately alkaline cleaners with corrosion inhibitors |
| Aluminum | Readily attacked by acidic and highly alkaline cleaners; use only soft metal-safe moderately alkaline cleaners |
| Wood | Should not be used in food applications; where used, clean with detergents containing surfactants |
| Iron drains | Acidic cleaners are corrosive; use moderately alkaline cleaners |
| Painted surfaces | Use moderately alkaline cleaners |
| Concrete | Use alkaline cleaners |

Acids and acid cleaners corrode concrete floors. Pitted or cracked concrete floors should be sealed with coating acceptable to the CFIA. A list of acceptable paints and floor coverings can be accessed at www.inspection.gc.ca/english/ppc/reference/cone.shtml

**Application** Chemical cleaners may be applied manually, in a soak solution, as a low-pressure wash or using an automated CIP system. Each application method has advantages and disadvantages. Most food processing facilities use a combination of these procedures.

### Manual Cleaning

Advantages:

- Low-cost equipment required; affordable in small operations
- Adaptable to all types and sizes of facilities, equipment and tools
- Milder, generally safer, chemicals used
- Immediate observation of cleaning efficacy

Disadvantages:

- Effectiveness often depends on worker industriousness
- Cleaning can be inconsistent
- Labour intensive
- Mild chemicals required for safe human handling may be ineffective
- Greater opportunity for cross-contamination by workers and tools

### Clean-Out-of-Place (COP) System

Advantages:

- Minimal labour required
- Longer period of time for cleaner to act

Disadvantages:

- Requires disassembly
- Soak tank often requires agitation to be effective
- Incorrect cleaner can damage equipment because of extended contact time

### Low-Pressure Wash

Advantages:

- Can be used for both rinsing and application of foam cleaners
- Fast application of cleaners on walls, floors and stationary equipment
- Easier to reach "hard-to-clean" areas

Disadvantages:

- Too high pressure may cause cross-contamination by aerosols and oversprays
- Low-pressure systems generally require higher volumes of water
- Loss of water temperature during application

### Clean-in-Place (CIP) System

Advantages:

- Reduced labour required with automation
- More consistent, effective cleaning
- More powerful cleaners can be used
- Optimal use of water and cleaner
- Cleans difficult to access areas (e.g., inside pipes)

Disadvantages:

- Higher capital cost; higher maintenance costs
- Not all equipment can be cleaned in place
- Easy to ignore automated systems; routine monitoring necessary to ensure system is working effectively

Surfactants (SURFace ACTive AgeNT) lower the surface tension of cleaning solutions (effectively making water "wetter"). Without a surfactant, water forms beads, which results in minimal contact with the surface and with soils. This means that the water (and the cleaner that it is carrying) does not penetrate surface crevices. However, a solution containing a surfactant spreads across the surface thoroughly, wetting soil particles and penetrating crevices. The result is more effective cleaning.

Surfactants are most often found in manual cleaners. CIP systems, where higher temperatures, stronger cleaners and greater pressures are used, generally do not require the addition of surfactants.

**Water** Water makes up 95 to 99 per cent of cleaning and sanitizing solutions. It carries cleaner and sanitizer to the surface and carries contamination away from the surface. Water impurities can drastically alter the effectiveness of a detergent or sanitizer.

***Water: Mineral Content*** Water used for food processing, cleaning and sanitizing activities must be potable (must meet Canadian Drinking Water Quality Standards). Minerals (calcium and magnesium salts) found in water can negatively affect the performance of cleaners and sanitizers. These salts not only tie up active ingredients, requiring higher application rates, but also may precipitate out as mineral scale. This scale is an ideal place for microorganisms to attach as a biofilm, in which they are protected from cleaners and sanitizers. In addition, scale buildup can reduce heat transfer efficiency and reduce the internal diameter of pipes.

### Summary of Water Hardness

| Water Hardness Rating | Calcium Carbonate Content (ppm) | Grains per Gallon |
|---|---|---|
| Soft | 0–60 | 0–3.5 |
| Moderately hard | 60–120 | 3.5–7 |
| Hard | 120–180 | 7–10.5 |
| Very hard | over 180 | over 10.5 |

Where hard water must be used for cleaning, the addition of chelating or sequestrating agents (a water softener) is necessary. Surfactants are sometimes mixed with water to reduce surface tension (making water wetter) and to help overcome water hardness.

Potential water (and ice) contaminants may be microbiological, chemical or physical. While all may cause adverse health effects, microbial contamination is generally of greatest concern.

### Water: Microbial Content

Water may contain enteric pathogens (bacteria, viruses and parasites), which can be transmitted to humans. While bacteria do not multiply in water, many can multiply in food. Viruses and parasites do not reproduce in food.

### Waterborne Pathogens

| | |
|---|---|
| Bacteria | *Salmonella, Shigella,* pathogenic strains of *E. coli* (e.g., O157:H7), *Vibrio, Heliobacter, Yersinia, Campylobacter* |
| Viruses | Noroviruses, Enteroviruses, Hepatitis A, Rotavirus |
| Parasites | *Giardia, Crytosporidium, Cyclospora, Amoeba, Toxoplasma,* Roundworms, Flatworms, Tapeworms |

### Water: Chemicals

Chemicals, such as pesticides, synthetic organics, nitrates, arsenic, lead, mercury and asbestos are sometimes found in water. In large enough chemical spills, incorrect use of pesticides, improper water treatment or cross-contamination with sewage or industrial waste.

### Water: Physical Characteristics

Physical characteristics of water including colour, odour, taste, temperature and turbidity (cloudiness) are primarily aesthetic and generally pose very small health risks, but may affect food quality.

The CFIA recommends that municipal water used in food processing should be tested twice a year by the processor. Water from other sources should be tested once a month.

Because use of contaminated water can cause severe consequences, many food processors test much more frequently; some as often as every day. Private laboratories perform *coliform* and *E. coli* water analysis for a fee in the $25 to $30 range. In addition to bacteria, food processors may also wish to test water for metals, minerals and pesticides.

## Sanitizer Selection

Sanitation may be achieved using either heat (thermal treatment) or chemicals.

### Heat

Hot water sanitizing is commonly used where immersing contact surfaces is practical (e.g., small parts, utensils). Both time and temperature are important.

Depending upon the application, sanitation may be achieved by immersing parts or utensils in 77°C to 85°C water for 45 seconds to 5 minutes.

A 45-second immersion in 77°C water is equivalent to immersion in:

- A 100 ppm chlorine solution for 45 seconds
- A 200 ppm quaternary ammonium solution for 45 seconds
- A 25 ppm iodine solution for 45 seconds.

Larger equipment may be sprayed with the same temperature water for the same period of time. However, it is important to remember that when cooler equipment is immersed in hot water or hot water is sprayed on cooler equipment, the water temperature will decrease rapidly, so killing power is lost. Hot water sanitizing is effective only when appropriate temperatures can be maintained for the appropriate period of time.

Hot water sanitation is easy to apply, readily available, effective for a broad range of microorganisms, non-corrosive, and penetrates cracks and crevices. However, it is relatively slow, can contribute to high energy costs, may contribute to the formation of biofilms, may shorten the life of certain equipment or parts (e.g., seals and gaskets), and can be a safety hazard to employees. Fungal spores will survive this treatment. Because hot water spraying is very energy inefficient and can raise the temperature of the surrounding area, this practice is generally not recommended.

**Chemicals** There is no perfect chemical sanitizer. Effectiveness depends on:

- Sanitizer concentration (too low or too high is ineffective)
- Surface contact exposure time
- Temperature of the sanitizing solution (generally, 21°C to 38°C is considered optimal)
- pH of the water solution (each sanitizer has an optimal pH)
- Cleanliness of the surface to be sanitized (an unclean surface cannot be effectively sanitized)
- Water hardness.

All sanitizers used in food production facilities in Ontario should be acceptable to the CFIA. The CFIA sanitizer list may be found at the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products*. It may be found at www.inspection.gc.ca/english/ppc/reference/cone.shtml#v

***Chlorine*** Chlorine is a most commonly used sanitizer in food production facilities. The effectiveness of chlorine depends on several factors:

- The amount of turbidity, organic matter, and presence of chemicals such as iron, manganese, hydrogen sulfide and ammonia in the water that "use up" chlorine
- The concentration of the chlorine solution added
- The time that chlorine is in contact with the organism
- The water temperature
- Water pH.

When chlorine is added to water, some of it combines with dissolved chemicals and organic material in the water and is "used up." Only the remaining "free" chlorine (hypochlorous acid) is available to destroy microorganisms present. Free chlorine levels can be easily measured using a commercially available test kit or a chlorine meter. Be sure to measure free chlorine levels, not the total chlorine. Frequent testing will ensure that chlorine concentration is maintained at levels required for sanitation. All measurements should be recorded in a log book.

Non-porous (e.g., metal, hard plastic) food contact surfaces should be sanitized with a 100–200 ppm "free" chlorine solution for a minimum of 45 seconds. A chlorine solution of 600 ppm is recommended for porous surfaces (e.g., wood, soft plastic) but, at this concentration, food contact surfaces must be rinsed afterward. Higher concentrations (e.g., 1,000–2,000 ppm) may be used on walls and floors. Contact time of two minutes is considered sufficient to reduce pathogen populations to an acceptable level when the surface is free of organic matter.

It is wise to wear protective clothing and eye covering when using chlorine solutions. Also, ensure that the area is well ventilated.

The following formula may be used to calculate the correct amount of chlorine to add to potable water to achieve a desired concentration.

$$\frac{\text{(desired ppm of chlorine)} \times \text{(total water volume)}}{\text{(\% hypochlorite in sanitizer)} \times (10{,}000)} = \text{litres concentrated chlorine required}$$

Sample calculation:

- 250 litres of 200 ppm chlorine solution required
- Unscented household bleach available as chlorine source (5.25% chlorine)

$$\frac{\text{(200 ppm chlorine)} \times \text{(250 litres)}}{(5.25\%) \times (10{,}000)} = 0.95 \text{ litres required}$$

The same formula may be used for granular bleach formulations (e.g., 65% calcium hypochlorite).

Always follow the manufacturer's instructions to determine the most efficient chlorine concentration. For example, when chlorine concentration is doubled, microbial killing time is reduced only 30 per cent (e.g., instead of 2 minutes at the manufacturer's concentration, at double that concentration, the killing time is 1 minute and 24 seconds). After sanitizing, allow the surface to air dry.

Temperature also affects chlorine effectiveness. Temperatures should be 24°C or a little higher (e.g., lukewarm/tepid water). Chlorine is ineffective above temperatures of 46°C. **A word of caution: dangerous chlorine gas is released if chlorine is used in hot water.**

Water pH[2] level influences the chorine concentration required for effective sanitation. The optimum pH is 6.5 to 7.0, but chlorine remains effective within a pH of 6.0 to 7.5. **If the pH falls below 4.0, dangerous chlorine gas (mustard gas) is produced.** Water pH should be checked after chlorine is added. pH may be adjusted with commercially available buffers.

Chlorine is relatively unstable, so chlorine solutions gradually lose strength, even in covered containers. This applies to both concentrated liquid chlorine (which has a maximum storage life of approximately six months) and mixed chlorine solutions (which have a maximum storage life of only 24 hours). If it has been stored for a period of time, check the concentration of stored liquid chlorine before mixing. Prepare fresh solutions frequently and check solution strength regularly while in use.

Chlorine is incompatible with most other chemicals. Do not mix chlorine with detergent cleaners. When mixing chlorine solutions, **always add concentrated chlorine to water to avoid possible explosions**; never add water to chlorine.

The most common chlorine-containing sanitizers are sodium hypochlorite and calcium hypochlorite, but chloramines, chlorine dioxide and dissolved gaseous chlorine are sometimes used.

***Iodine/Iodophors***

Iodophors (a mixture of iodine and surfactant) have broad-spectrum activity against bacteria, viruses, yeasts, moulds, fungi and protozoans. Although less affected by organic matter and water hardness than chlorine, iodophors have a limited effective temperature range (24°C to 34°C). They are least effective at low temperatures and vapourize at 49°C. They are most effective at low pH (2.5–3.5) levels. Iodophors have 2.5 times the oxidizing power of chlorine so a lower concentration is required (e.g., 25 ppm). Iodophors can also stain and discolour equipment, especially plastics. They are widely used in the meat industry.

---

[2] pH is a measure of the acidity or alkalinity of a liquid. If the pH is below 7.0, the solution is acidic. The lower the number, the greater the degree of acidity. If it is above 7.0, the solution is alkaline. The higher the number, the greater the level of alkalinity. A pH of 7.0 is neutral (neither acid nor alkaline.)

Because iodine/iodophors are non-irritating to skin and have a longer shelf life than chlorine, they are often used in hand-dip solutions.

**Quaternary Ammonium Compounds ("Quats")**

A diverse class of compounds, "quats" are the only sanitizer group with true residual activity. For this reason, they are often used on floors, walls, and drains, and on equipment that will remain idle for longer than 24 hours. Because quats contain surfactants, they can be "foamed" onto vertical surfaces. A concentration of 200 ppm at 24°C to 44°C with a contact time of 45–60 seconds is required for sanitation. Because quats adhere to surfaces, food contact surfaces must be rinsed before use.

Quats are non-corrosive, odourless and non-staining; effective on porous surfaces; and work well over a wide pH range. Their effectiveness diminishes in hard water. Organic matter moderately affects their efficiency.

Quats have limited use in processed fruit and vegetable applications. While they are effective at killing yeast and mould, their effectiveness against *coliforms*, *Pseudomonas spp.*, (produce spoilage bacteria), pathogenic *E. coli* and *Salmonella spp.* is limited. They are not compatible with common detergent compounds or chlorine sanitizers.

Compared to chlorine, quats are relatively expensive.

**Phenols**

**Do not use phenols in food processing plants.** Phenol odours can penetrate food, causing objectionable flavours and odours in the food. Their use should be limited to washrooms.

**Peroxyacetic Acid (PAA)**

Peroxyacetic acid is effective against a broad spectrum of *coliforms*, bacteria, yeast and moulds. It is effective at temperatures from 5°C to 40°C and at a pH up to 8.0. It decomposes to acetic acid (vinegar), water, oxygen and carbon dioxide.

PAA is most commonly used in fresh-cut, further processed, and post-harvest fruit and vegetable flume and wash water systems, especially in applications where high organic matter would significantly decrease the effectiveness of chlorine. Different formulations are designed to be used directly on whole and processed fruit and vegetable surfaces, on food and non–food contact surfaces, and in clean-in-place (CIP) systems. Rinsing is generally not required.

Peroxyacetic acid can be very expensive.

### *Biological Cleaners*

Bio-chemical cleaners are a relatively new product used to clean non–food preparation areas (e.g., floors and drains) of fat-oil-grease buildup (FOG). They are formulated using a number of strains of harmless, non-pathogenic bacteria. They work by decomposing and digesting protein, human waste and other organic matter. As long as a food source is available, the bacteria continue to multiply and eat. When the food runs out, they die. Carbon dioxide and water are produced as byproducts.

### Selecting a Supplier

Selection of a cleaner and sanitizer supplier is extremely important. As well as supplying chemicals, the supplier should also be able to provide informed expertise regarding chemical selection and use. Periodically, it is wise to review the cleaning and sanitation program to determine if it is effective. This review may include post-sanitation tests for microbes (environmental swabs) on selected surfaces in the facility.

## Cleaning and Sanitation Methodology

Good housekeeping practices are precursors to effective cleaning and sanitation. Neatness, tidiness and orderliness reduce contamination and make cleaning easier. Good housekeeping should be the responsibility of **everyone** in the facility.

Effective cleaning and sanitation creates production efficiencies. If soil and water are not regularly removed or are incompletely removed during cleaning and sanitation, microorganisms will multiply rapidly. Once the "safe" level of microorganisms is exceeded, the safety of the food product being produced becomes problematic. Therefore, the more effective the cleaning and sanitation, the lower the initial level of microorganisms and the longer the production period before further cleaning is necessary.

Cleaners remove soil and a portion of the microorganisms. Sanitizing, which reduces the microbial population to safe levels, may be achieved by the use of chemicals or by the use of heat (hot water or steam). Because sanitizing requires direct contact between the sanitizer and the microorganisms to be killed, surfaces must be clean before a sanitizing solution is used. The presence of organic matter significantly reduces the killing power of sanitizing solutions.

Processing equipment should be sanitized immediately after cleaning and again prior to use, if sanitizing took place more than four hours previously.

The following steps are required for cleaning and sanitizing:

1. Remove/cover food, ingredients and packaging materials from the area to be cleaned. Cover electrical equipment and other special equipment that could be damaged by water.

2. Using brooms, shovels, squeegees, etc., physically remove as much soil and other debris as possible from equipment, utensils, preparation areas and floors. Place in clearly marked "inedible" containers for prompt disposal. In addition to reducing water usage, "dry" cleaning will reduce the risk of cross-contamination caused by water overspray and lessen opportunities for high-risk drain pooling and backups.

   Disassemble equipment, as required. Do not place disassembled food contact surface equipment on the floor. Even if it is cleaned and sanitized before reassembly, its floor "storage" location may prevent complete sanitation. Clean, dedicated carts or racks should be provided to clean and sanitize or to transport disassembled pieces to appropriate soak or circulation tanks for cleaning and sanitizing.

3. Using 43°C to 50°C potable water, rinse walls from the top down, equipment from the top down and in the direction of product flow, and floors. Don't forget the underside of counters, tables, belts, etc., and other cracks and crevices where soil may be hidden. Use the lowest effective water pressure (increase volume to compensate for decreased pressure) to reduce the risk of cross-contamination caused by aerosols and oversprays. Excessive pressure may also cause machine damage. Where conditions require higher pressures

to remove surface soils, these high-pressure sprays must be limited to this step during cleaning procedures.

Following this step, walls, equipment and floors should look clean.

4. Apply cleaning agents to loosen any remaining "invisible" soil and keep it in suspension. Apply to walls, floors and equipment, in that order, at the correct concentration and temperature. This will reduce the potential for cross-contamination and prevent detergent from drying on equipment surfaces. Cleaning solution **must** be applied to every square centimetre of surface including all food contact surfaces and undersurfaces.

   Every cleaning agent has an optimum concentration level at which soil removal is most efficient. Too high a concentration is as ineffective as too low a chemical concentration. Always follow manufacturer's directions carefully.

   It is generally assumed that the hotter the water used in cleaning the better the cleaning job. This is true only to a point. A water temperature between 43°C and 50°C is best for efficient cleaning. Water that is too hot may cook the soils onto the surface.

   Generally, the longer the contact time of the chemical cleaning agent on the surface being cleaned, the better. Check manufacturer's instructions for minimum exposure time.

   Some surfaces may require extra scrubbing. Manual cleaning may include using brushes or other hand-operated equipment to remove soil from surfaces. Cloths and sponges can harbour and spread microorganisms from one area to another, so their use should be avoided. Abrasive materials (e.g., steel wool) may scratch surfaces, leading to eventual corrosion. Abrasive materials may also leave behind tiny metal particles that could end up in the food. Clean, sanitized nylon scouring pads should be used instead. Brushes and brooms with food-grade plastic handles and bristles may be used. Squeegees may be used on floors and walls, but must be constructed of materials acceptable to the CFIA (e.g., food-grade plastic).

Mechanical cleaning may include water hoses with a spray head, pressure spray devices (high or low pressure using hot or cold water), or steam guns. High-pressure water should be used only after preliminary cleaning has been completed in order to lessen the possibility of contamination by aerosols caused when high-pressure water hits contaminated surfaces.

Using foaming solutions allows cleaning solutions to stick to vertical surfaces for a longer period of time. Foam should be applied from the bottom up and rinsed off from the top down.

Closed systems require turbulent flow of water, cleaning agents, water, sanitizing agents, and water (in that order) through pumps, valves, connections, pipes and tanks. This is described as cleaning-in-place (CIP). The optimum water temperature is usually 60°C.

Some equipment must be taken apart for cleaning and sanitation. Cleaning out-of-place (COP) requires a soak or circulation tank, which comprises four compartments. Disassembled equipment and utensils are soaked/rinsed in the first compartment, manually cleaned with a cleaning compound in a least 43°C solution in the second, rinsed in the third in 43° to 50°C water, and sanitized in the fourth with either chemical sanitizers or 77°C water for 45 seconds. In a circulation tank, the velocity of recirculating water, combined with chemical cleaners, cleans equipment parts and utensils. Where three compartment tanks are used, initial cleaning must be "dry" (see step 2 above).

5. Even on vertical surfaces, minute amounts of cleaner may remain after cleaning. (Cleaners are formulated to "stick" to surfaces.) Thorough rising carries away the remaining soil (a biological contamination risk) and the cleaning agent (a chemical contamination risk). Use the lowest effective pressure and volume to avoid aerosols and oversprays. Rinse walls first (from the top down) followed by the floor and drains, with equipment and food contact surfaces (from the top down and in the direction of product flow to keep track of what has been rinsed) last. This order will avoid the potential risk of overspray or splashing on equipment that is considered clean. As noted above, only potable water must be used.

6. Before reassembling equipment, someone not involved in the actual cleaning should conduct an organoleptic (sight and smell) inspection to check that walls, equipment, utensils, food contact surfaces and undersurfaces, floors, and all nooks and crannies are clean. Use of a flashlight may be helpful. Areas that are not completely clean must be cleaned and rinsed again.

7. Much of the floor probably will be covered with cleaner when equipment is cleaned. However, it may be necessary to scrub areas that have been missed. Allow cleaning agents to stand for an appropriate time, then rinse. Don't forget to remove drain covers and to clean inside drains (see "Important Considerations" below). Be careful not to use excessive water pressure that may create equipment-contaminating aerosols.

8. Apply sanitizing solution at the correct concentration, the correct temperature and for the appropriate contact time to floors first. Then move to equipment, beginning with support structures and working upward until all surfaces are completely covered. As with cleaners, sanitize in the direction of product flow to keep track of what has been done.

   After the use of some sanitizers and certain concentrations of others, rinsing with potable water is necessary. Rinsing normally eliminates all traces of chemical sanitizers, but only when all surfaces are flushed with a sufficient volume of water.

   As noted in the Heat Sanitation section above, hot water sanitizing is commonly used where immersion of the contact surfaces is practical (e.g., small parts, utensils). Depending upon the application, immersion may last from 45 seconds to 5 minutes at temperatures from 77°C to 85°C.

9. After rinsing, the surface should be air dried to eliminate chemical odours. Drying should be as swift as possible to discourage microbial growth. In some areas (e.g., belt surfaces, floors), it may be necessary to squeegee off water to speed the drying process. Surfaces should never be dried with a cloth or towel that can contaminate the freshly sanitized surface with microbes.

Sophisticated operations may lower the relative humidity in the facility so water evaporates more quickly.

Food processors may wish conduct microbiological tests (via environmental swabs) to confirm that food contact surfaces are free from harmful microorganisms. A brief discussion of verification tests follows in Section O3.2.

10. **"If you don't write it down, it didn't happen."** As part of the Sanitation Standard Operating Procedure (SSOP), a record indicating completion of cleaning and sanitation activities should be kept. Deviations from prescribed practices and other irregularities should also be noted, as should the corrective actions taken.

**SSOP**

Cleaning and sanitation procedures appropriate to your facility and equipment should be included in a written Standard Sanitation Operating Procedure (SSOP). See the "Control Programs" section for details.

**Important Considerations**

It is important to understand that **sanitation is a sequence of steps** with each step building upon successful completion of the previous step. To prevent potential cross-contamination, each step must be fully complete before the next step occurs. For example, if one sanitation worker is performing a pre-rinse procedure on a machine beside another machine where another worker is doing a final rinse, there is a risk that an overspray from the dirty first machine may contaminate the clean, sanitary surface of the cleaned machine.

**The warmer the temperature, the faster microbes grow** and reproduce and the more frequent the requirement for cleaning and sanitation. As a rule of thumb, for every 6°C rise in temperature of the food ingredient or product, the rate of microbial growth increases by 50 per cent. For example, at 16°C, the rate of microbial growth in food debris in a processing plant is 50 per cent greater than if the temperature is 10°C. The vast majority of human pathogens have optimal growth at temperatures of 25°C to 40°C. (The human body is 37°C.) It should be noted that *E. coli* grow at temperatures as low as 10°C, *Salmonella* at temperatures as low as 7°C and the spoilage bacteria *Pseudomonas* as low as 4°C. A microbiological monitoring program can be used to determine the period of time necessary between cleanups.

Pay special attention to areas where **trapped food and water create ideal growing conditions for microorganisms**. These include cracks in floors, pools of standing water, clogged floor drains, tape used for temporary repairs, exposed insulation, open-design conveyor belts, the underside of conveyor belts, hollow rollers, fixed sleeved assemblies, concave surfaces, and crannies and crevices in poorly designed manufacturing equipment. Each of these areas can provide an environment in which bacteria (including pathogens, if they are present, and spoilage microorganisms) can survive and grow.

**Drains are an especially high-risk area** because they provide an ideal environment for the growth of the pathogen *Listeria monocytogenes*. To discourage *Listeria* growth, clean drain covers and the inside of drains on a regular schedule. Sanitation personnel who handle drain components should be prohibited from cleaning food contact surfaces or equipment until protective outer clothing has been replaced, footwear has been cleaned and sanitized, hands have been washed and gloves replaced.

As with personnel, **sanitation tools should be limited to specific functions**. To ensure that this happens, colour-coded tools should be used. For example, one colour should be dedicated to food contact areas, another to non–food contact areas and a third for cleaning drains and other similar areas.

**Aerosols created by high-pressure/low-volume water cleaning can be a source of cross-contamination** by carrying microorganisms from non–food contact surfaces to food contact surfaces. Whenever possible, do not use high-pressure air or water to clean food processing and food storage areas. Where pressure sprays cannot be avoided, take care to create as few aerosols as possible. Pressure sprays should never be used as a final rinse because any resulting cross-contamination will negate previous cleaning and sanitation.

**Certain items require special cleaning and sanitation systems**. For example, dirty control buttons can transfer microorganisms to hands, which, in turn, contaminate food, ingredients, food contact surfaces or packaging. Because control buttons are covered for worker safety during cleaning, a safe, effective cleaning and sanitation procedure must be developed for them. Another example is that only one side of screens may be readily accessible for cleaning and sanitation. This may create a potential area of cross-contamination. In this case, develop procedures to remove screens or partially dismantle equipment to enable complete cleaning and sanitation. Water and/or chemicals may also penetrate sealed surfaces such as bearings if they are cleaned and sanitized improperly. In addition to causing premature wear, penetration may create an entrance for microbes and provide an inaccessible niche for microbial growth.

**Applying sanitizer at levels at too low a level or for an insufficient period of time can lead to higher bacterial levels and/or to development of resistant strains of microbes.** When this occurs, the area must be "shocked" back to a safe bacterial level by switching to high concentrations of another sanitizer for several days.

**A good pest control program is necessary** for a cleaning and sanitation program to be effective. Pests, including birds, mice, rats and insects (e.g., flies, cockroaches), can contaminate a food processing facility with urine and droppings, can damage packaging supplies with their gnawing and can spread a variety of pathogens as they move around the building, equipment and food contact surfaces. Even areas that have been cleaned and sanitized can be recontaminated. Pest control options are outlined in Section O5.

### Automated Versus Manual Cleaning

Automated cleaning systems will improve cleaning by consistently controlling cleaner/sanitizer concentration, solution pH and temperature, cleaning/sanitizer contact time, and the mechanical force used during cleaning. Automated systems also reduce labour hours and reduce cleaning hours. However, manual cleaning requires less capital outlay, and no re-engineering or retrofitting of the facility is necessary. The benefits of automated cleaning systems are generally greatest in larger operations with large and/or complex equipment.

When meters are used to automatically mix cleaners and sanitizers, the concentration should be checked every day with a commercially available test kit to ensure that it is correct.

### Pre-Operational Assessment

**O3.2 Operations begin only after pre-operational assessment to evaluate the suitability of the environment for food processing and handling has been completed with satisfactory results. When sanitation activities are required during operations, a pre-operational assessment is conducted before resuming operations.**

No food processing should begin or resume until the production area meets all SSOP requirements necessary to prevent contamination of food, ingredients, packaging materials and food contact surfaces. Inadequate sanitation can lead to biological (e.g., bacteria remaining on food contact surfaces), chemical (e.g., sanitizer residues) or physical (e.g., dust and dirt) contamination.

It is not good enough that facility floors, walls and equipment simply look clean; plant, equipment and food contact surfaces should be verified as free from microbiological contamination. This can be accomplished only by an effective environmental sampling and testing program.

The locations chosen for sample gathering are critical. Search out environments that microorganisms prefer for routine sampling. This will include food contact surfaces (e.g., conveyors, fillers, packaging), processing equipment (e.g., slicers), non–food contact areas (e.g., drains, floors, equipment support framework) and air in the production area. In addition, out-of-the-ordinary places should be sampled periodically to prevent unwanted surprises.

ATP bioluminescence (using a luminometer) is a quick and easy indicator if organic matter (in which microorganisms can grow) remains on the surface. Bioluminescence does not indicate how many or what kind of microorganisms or chemical contaminants remain on the surface.

A number of rapid microbiology test kits are commercially available to identify the type of bacteria present. These kits can be used in the production area. Results take only a few minutes.

If a problem is indicated by these rapid tests, traditional laboratory microbiological methods should be performed to confirm the type and number of microorganisms present. On food contact surfaces, *coliform*, *E. coli* or Total Plate Count (TPC) tests may be conducted. *Listeria* tests may be performed on non–food contact surfaces. Results from these tests may take two to five days.

Some processors may also wish to include inspection for allergens, pests, and temperature control, and conduct routine equipment maintenance and safety evaluations in their pre-operations program.

**SSOP** Appropriate pre-operation procedures should also be included in a written Sanitation Standard Operating Procedure (SSOP).

## O4 EQUIPMENT MAINTENANCE

**Preventative Maintenance**

**O4.1 Preventative maintenance and calibration activities are performed in a way that protects the safety and suitability of food.**

A preventative maintenance program can reduce biological, chemical and/or physical food safety risks, as well as saving money on unexpected repair costs, saving time from unscheduled downtime and maximizing equipment performance.

These are just a few examples of potential food safety risks: microbial risks may result from increased bacterial growth on foods or ingredients stored in a cooler with improper temperature control; worn, cracked gaskets may harbour bacterial growth that is inaccessible to cleaning; worn moving parts, such as disintegrating bearings, may create metal fragments that contaminate food or ingredients; and equipment designed to meter sanitizers, such as chlorine, may be unable to maintain proper settings, resulting in chemical residues on the final product.

**What Is It?** Preventative maintenance may include inspection, testing, lubrication, cleaning, adjusting and replacement of parts based on the equipment manufacturer's recommendations and the operating conditions. A written preventative maintenance program should include a list of the equipment requiring regular maintenance and the maintenance procedures and frequencies required. Hidden screens and filters must not be neglected. Only designated, appropriately trained personnel may perform maintenance procedures.

According to a study by the Japan Institute of Plant Maintenance (JIPM), correct and effective lubrication can prevent the majority of mechanical failures and the resulting food safety and quality issues. A colour-coding system where the lubricant container, the application tool and the point of application on the equipment are the same colour lessens the opportunity for error. Equally inappropriate to using the wrong lubricant is using too much or too little of the right lubricant.

A system should be in place that allows employees to report items that require maintenance.

**CFIA Acceptable**

All repair parts and materials used in the production of food should be of food-grade quality. Only lubricants acceptable to the CFIA should be used. A list of acceptable materials and lubricants may be found at www.inspection.gc.ca/english/ppc/reference/dppe.shtml, the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* website. The listing is also available through CFIA offices.

**Cross-Contamination**

During extended breaks, product integrity must not be compromised. Perishable product must be promptly transported to appropriate storage and "sensitive" product fully covered or removed from the area to prevent cross-contamination.

During maintenance and repair activities, great care must be taken to avoid cross-contamination by workers and by equipment/tools. Understandably, maintenance personnel are often more concerned with the technical aspects of repair than with the food safety implications. Contractors and temporary employees may be even less food-safety minded. As a minimum, all maintenance personnel should have GMP training in handwashing, traffic patterns, hair coverings, uniforms, and eating/drinking/smoking policies.

Cross-contamination control may mean separate tools and/or clothing for specific areas of the facility. Following completion of the maintenance/repair activity, there should be a reconciliation of tools, parts, gloves and other materials to ensure that nothing is inadvertently left behind to biologically, chemically, or physically contaminate food, ingredients or packaging. An assessment of the need for cleaning and/or sanitation of the immediate area should be undertaken by an assigned individual.

Temporary repairs must be just that. Materials inappropriate to food processing areas can soon become the cause of contamination. For example, something as innocuous as duct tape may quickly fray and fall into food products where it may not be easily detected.

Records of all maintenance activities should be kept. Records will verify the effectiveness of the maintenance program and should include identification of the equipment, the maintenance activity, the date, the person performing the maintenance, and the reason for the maintenance activity. A work order system may be an effective maintenance reconciliation tool.

**Calibration/Adjustment** Calibration ensures that equipment measures or monitors with accuracy and consistency. Correct calibration will ensure production of a safe product in accurately measured quantities. For example, an improperly calibrated cooler thermostat that reads 4°C below the actual temperature can create an environment inside the cooler that encourages bacterial growth on foods or ingredients.

Devices that need periodic calibration may include pH and chlorine reading devices, thermometers, temperature recorders, timing devices, pressure gauges, scales, metering devices, temperature control units, metal detectors and luminometers. Manufacturers of measuring and monitoring instruments have written calibration methods and frequencies. These procedures should be followed carefully by appropriately trained personnel. Manual confirmation (e.g., comparing the chlorine concentration reading of a commercial chlorine test strip with a reading from the measuring device) will provide some degree of confidence that the calibration is correct. Critical devices such as metal detectors and scales should be calibrated by an accredited outside agency or the manufacturer at predetermined frequencies to ensure their accuracy.

Keep records of all calibration activities. Should food safety, quality or other issues develop with finished product, improper calibration and the resulting improper measurement may be determined as the cause.

**SOP** Maintenance/calibration procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

## O5 PEST CONTROL

**Pest Control Monitoring**

**B5.1 Pest control procedures are performed in a way that protects the safety and suitability of food.**

Pests including birds, mice, rats and insects (e.g., flies, cockroaches) contaminate the fruit and vegetable processing facility with urine and droppings, damage packaging supplies with their gnawing, and spread a variety of pathogens as they move around the building, equipment and food contact surfaces. Even areas that have been cleaned and sanitized can be recontaminated.

**Discouraging Pest Entry**

All pests require moisture to survive. Therefore, roofs must be watertight, and walls and foundations must not allow water to enter the building.

Birds can be kept out of the building if doors and windows are tightly fitted and kept closed. Any other openings in the walls, foundation, eves or roof should also be repaired, sealed or screened to discourage pest entry. Except when in use, keep all doors closed at all times.

Mice can fit through openings as small as 6.5 mm. If a pencil can slide under the door, mice can enter. Openings around vents, wires, pipes and drains should be sealed with sheet metal, wire mesh, silicone caulking or concrete. Mice can jump up to 0.3 m high and can climb vertical surfaces, so all building openings, including those around doors and windows, should be tightly sealed using a silicone caulking.

Mice and rats are discouraged by open spaces. A minimum 75-cm wide vegetation-free, debris-free, gravel, concrete or bare-soil open space should border the outside of all buildings. Eliminate food sources attractive to pests, such as garbage. Store garbage and recycled goods (e.g., cans, cardboard, paper, etc.) far enough away from the building to discourage rodent travel between the two.

Cracks and crevices are ideal areas for insect breeding and harbourage, as are small spaces between cabinets and equipment (e.g., a 6-mm space between a cabinet and wall or a 2.5-cm space between equipment and the floor). Cabinets should be sealed tight to the wall. If this is not possible, a minimum 15-cm space should be left between cabinets and equipment and walls and floors.

Without proper housekeeping, effective pest control is impossible. Remove trash, debris and clutter that rodents find desirable for hiding and nesting, and eliminate food sources such as garbage. Accumulations of debris also provide escape routes. According to studies by the Alberta Department of Agriculture, Food and Rural Development, mice travel in an area up to 9 m from their nests in search of food, shelter and water.

Cockroaches and their egg capsules can be carried into buildings inside packages, boxes, and recycling bins (even those containing non-food supplies). Inspection criteria for incoming supplies (described in Section O2.3) should include monitoring for cockroaches.

Cockroaches live in high humidity, food-accessible, ground-level areas where they can hide in cracks and crevices that touch their bodies from both above and below. Elimination of living and harbourage areas deters their presence. A cockroach sighting during daylight is a sign of widespread infestation of the facility. When buildings are heavily infested with cockroaches, the excess population may migrate to outside garbage containers and dumpsters.

Foodstuffs that cannot be stored in rodent-proof containers should be stacked on pallets 35 cm apart, 45 cm away from walls and 15 cm off the floor.

Where practical, air curtains at doors discourage entry of flying insects.

### Pest Monitoring Outside the Building

There should be routine monitoring outside the facility for evidence of pest activity. Evidence may include nesting activity within 9 m of the facility. The presence of rodent droppings indicates that a nest is nearby and that control measures should be taken. There may be decomposed rodents or animals in bait stations. Burrowing, urine stains, footprints or evidence of gnawing are also indications of pest activity.

Monitoring should include verification that outside pest control devices are in good repair and in working order, and have the right amount of fresh bait. Exterior traps should be routinely monitored at least once per month.

Garbage dumpsters and other garbage storage areas should also be monitored regularly for evidence of pests or their activity. A discussion of proper waste management may be found in Section O2.10.

## Pest Monitoring Inside the Building

As outside the building, decomposed rodents or animals in bait stations inside the building are evidence of rodent activity. Urine stains, footprints or gnawing are also indicators of pest activity. Insects or flies on ingredients, food products, equipment or garbage, and/or insect, fly, rodent, or bird excreta inside the building, also indicate that pests are present.

A bright flashlight is a useful tool for examining dark, undisturbed or remote areas for signs of dark-loving rodents and cockroaches. Sticky traps, strategically placed near food sources, are often used to monitor for the presence of cockroaches.

Monitoring should also include verification that each pest control device is in good repair and in working order. Where no evidence of rodents has been discovered, interior traps should be routinely monitored at least twice per month. Where evidence has been found, traps should be monitored daily.

Storage and processing areas should be kept clean and monitored regularly for telltale signs of mice or rats. Rodent droppings should be cleaned up immediately for sanitation reasons and to make new rodent activity easier to spot. If evidence of rats or mice is detected, several control methods may be used.

## Rodent Traps

**Poison bait must never be used inside the building** where it can contaminate ingredients, food products, packaging or equipment, and endanger workers.

Snap traps are inexpensive, effective, and humane, and eliminate the need for hazardous poisons within the facility. Traps should be placed close to walls, behind objects, in dark areas and in places where rats or mice have been detected. Traps should be spaced approximately 8 m apart around the interior perimeter of the facility including employee areas, dry storage areas, coolers and processing areas and within 3 m of each exterior door. Position traps so the rat or mouse passes over the trigger in its normal travel path but not in areas where the traps may contaminate ingredients, food products, packaging or equipment. Use plenty of traps so the problem can be eliminated quickly before the mice or rats become trap shy.

Glue traps, sticky boxes or tube traps may also be used. Unlike snap traps, they do not kill instantly. Be prepared to deal with live rodents if these traps are used. Wear heavy gloves to transfer trapped rodents to a bucket of soapy water where they may be disposed of by drowning.

### Rodenticides

Draw a map of the location of each device so that none are inadvertently missed during monitoring and servicing.

Rodenticides are chemicals that must be used only outside the building. They may be anticoagulants or non-anticoagulants. All rodenticides used in Ontario must be registered under the Pest Control Products Act and Regulations (http://laws.justice.gc.ca/en/P-9/index.html) and used in accordance with label directions. A list of CFIA-accepted pesticides, including rodenticides, can be found under *Pesticides* on the CFIA's website at www.inspection.gc.ca/english/ppc/reference/dppe.shtml. These pesticides must be properly labelled and stored in a locked area. Poison bait must never be used inside the processing facility where it could contaminate ingredients, food products, packaging material or food contact surfaces.

Exterior bait stations should be placed no more than 16 m apart and near openings and in places where rats and/or mice are active. Traps or bait stations should also be placed within 3 m of exterior doors, on both sides. Bait should be checked often for freshness, and old or mouldy bait should be replaced. Bait stations should be clearly marked and tamper-resistant (require a tool to open) to safeguard people and pets. To prevent them from being moved (or removed), secure bait stations by attaching them to a patio block, chaining them to the building or anchoring them to the ground. Bait stations must not be placed in public areas.

Exterior traps should be monitored often. Dead rats and mice should be removed (wearing gloves to avoid personal contamination) and bait replenished (again wearing gloves).

All pest control chemicals must be used in accordance with label directions.

One problem encountered with rodenticides is that dying mice and/or rats enter the building then die. When cleaning up dead rodents, or even rodent droppings, several precautionary steps should be taken. Never dry sweep. Dry sweeping rodent droppings can cause dust containing viruses to become airborne. Always wear rubber gloves. Thoroughly spray droppings and the surrounding area with a 5,000 ppm chlorine solution (1 part 5.25

per cent household bleach to 10 or 11 parts water). After spraying, clean the area and place all debris in the garbage.

Rodent droppings should be cleaned up immediately for sanitation reasons and to make it easier to spot new activity.

**Dogs and Cats** Dogs and cats are an ineffective method of rodent control. Although they are not generally considered to be pests, they too are capable of carrying biological and physical contaminants. Under Section 59(e)(ii) of Regulation 562 of the Health Unit–enforced Health Protection and Promotion Act "every room where food is manufactured, prepared, processed, handled, served, displayed, stored, sold or offered for sale is kept free from … live birds and animals." Therefore, pets must be kept out of food processing facilities.

**Insect Traps** Flying insects can often be controlled with light traps. Low-voltage traps consist of an attracting light, a replaceable sticky board onto which the insect becomes attached and a bottom tray to catch insects that do not remain attached to the sticky board. Traps must not be hung directly above exposed food, food ingredients or food contact surfaces. To remain effective, glue boards must be replaced regularly. High-voltage light traps electrocute insects and often cause them to explode. For this reason, they must not be used within 9 m of exposed food, food ingredients, or food contact surfaces or within 3 m of packaged product.

Insect control devices may be used near exterior entrances but should not be positioned so that they attract insects from outside the building into the building. Exterior lights should also be positioned away from the building to discourage insects from swarming near the building.

**Pest Control Operator** In many instances, pest eradication is best left to a certified pest control operator (PCO) who is licensed by the Ontario Ministry of the Environment (MOE) under regulations of the Pesticides Act. PCOs have the training, expertise, experience and equipment required to ensure an effective pest control program.

Processing facility operators who undertake their own pest control activities must be fully committed to consistent application of the program. Too often the responsible person is diverted to other more "important" tasks, is ill, goes on vacation, quits, etc. This creates unacceptable lapses in pest monitoring and control. In-plant personnel must also be trained in the safe handling of pesticides and be licensed to purchase and use them.

To facilitate effective pest monitoring and control, a **written pest control program should be developed**. Such a program should:

- Assign a staff person to be responsible for pest control or choose a pest control operator (PCO)
- Outline the responsibilities and activities of the staff person or PCO
- Schedule pest control activities
- Specify the pesticides and mechanical devices to be used
- Include a map indicating the location and type of each internal and external pest control device (e.g., glue boards, insect light traps, tin cats, mechanical traps, etc.), with each numbered for ease of tracking
- Outline the documentation required to record the chemicals used, where these chemicals were used, any signs of pest activity, the corrective action taken in the event of pest activity, and the signature of the PCO as verification of his or her activity.

In addition to the pest control program, the pest control file should include current licences and insurance documentation of the PCO (if one is employed) or the licences/qualifications of the staff person performing the pest control tasks.

**SOP** Pest control procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

## O6 RECALL

**Product Code/ Label Monitoring**

**O6.1 Food products stored within or shipped from the establishment are correctly labelled and coded with a lot code or production identified.**

A recall may be instituted by either the food processor (e.g., as a result of customer complaints) or by the Canadian Food Inspection Agency (e.g., negative microbial or chemical tests, unreported allergens, incorrect labelling, etc). Regardless of the instigator, a recall program must ensure that product identified as defective is removed from the market as efficiently, rapidly and completely as possible.

**Recall Program**

A written recall program should include:

- The person(s) responsible for co-ordinating and implementing a recall
- Procedures to identify, locate and control the implicated product
- Measures to investigate violation causes and steps to control them
- Procedures to test effectiveness of the recall at predetermined intervals.

**Product Code/Records**

To facilitate successful product recovery, all products must be clearly identified with a permanent, legible code or lot number for traceability. If the food product in question does not have a unique identity code, it cannot be separated from all other similar product. If it cannot be separated, corrective actions may be taken against *all* similar products.

A code or lot number must meet the following criteria:

- It must be permanent and legible at all times.
- The meanings of the codes must be explained in writing and be readily available.
- It must facilitate product tracking.
- The code may be for a maximum of one day's production.

Product identification and accompanying production records must permit traceback to incoming raw ingredients and packaging materials and to potential contamination points during production, processing and/or packaging. These records may also be used as a tool to investigate wholesale and retail customer complaints that do not result in a recall.

Once the defective or suspect product has been returned to the processor, this product and remaining inventory of the same lot(s) should be clearly identified and isolated in a designated area. All products within the identified code(s) must be accounted for, including everything that has been sold, recalled or remains in inventory. If the CFIA initiated the recall, it will ultimately decide the fate of the recalled product.

Comprehensive production, product coding and distribution records must be kept for a period of time that exceeds the shelf life of the product.

Coding practices appropriate to your product(s) should be included in a written Standard Operating Procedure (SOP).

**CFIA Recall** Canadian Food Inspection Agency (CFIA) food recalls are classified based on the degree of risk to consumer health.

- A Class I recall is a situation in which there is a reasonable probability that the use of, or exposure to, the product in question will cause serious adverse health consequences or death.

- A Class II recall is a situation in which the use of, or exposure to, the product in question may cause temporary adverse health consequences or where the chances of serious adverse health consequences are remote.

- A Class III recall is a situation in which the product is unlikely to cause any adverse health reaction, but one that violates labelling or manufacturing regulations.

When the CFIA orders a recall, it will ask for the following information:

- Recalled product identification—description of the product, code(s) or lot number(s)
- Distribution details—number of units packed with their code(s), number distributed, dates(s) distributed and number remaining in the producer's possession
- Names, addresses, and contact information of retailers and wholesalers where recalled product has been distributed

- Information on any other product that may also be affected by the same hazard
- Contact information for the reporting producer.

Product code information, distribution records, and customer and employee contact lists must be kept current and must be readily available. Responsibility for managing these lists should be assigned.

**Labelling** All of the information on food labels must be true (not misleading or deceptive) and accurately describe its ingredients and carry allergen warnings, if applicable. Incorrect labelling can lead to a CFIA-initiated recall.

Retail labels must contain all information required by the Consumer Packaging and Labelling Act and its regulations. It may be accessed at http://laws.justice.gc.ca/en/C-38/index.html. Health Canada's amendments to the Food and Drug Regulations regarding nutritional labelling, nutrition claims and diet-related health claims came into effect on December 12, 2005. (For small manufacturers with gross revenues of less than $1,000,000 from food sales, the regulations come into effect on December 12, 2007.) During transition to the new regulations, the Canadian Food Inspection Agency's *2003 Guide to Food Labelling and Advertising* may be found at www.inspection.gc.ca/english/fssa/labeti/guide/toce.shtml. For guidance regarding allergen labelling, a CFIA Fact Sheet titled *Labelling of Foods Causing Allergies and Sensitivities* is available at www.inspection.gc.ca/english/fssa/labeti/allerg/allergense.shtml.

Required information includes the common name, a net quantity declaration, the dealer name and address (the "responsible party" to be contacted in the event of problems), and a list of ingredients.

Prepackaged fresh fruits and vegetables are exempt from regulations that require a durable life date ("best-before" date) on prepackaged foods with a durable life of fewer than 91 days. Some processors may wish to provide this information voluntarily or to include the production date on the label.

Fresh vegetables and fruits without added ingredients and fruit and vegetables coated with paraffin wax or petrolatum are also exempt from displaying a Nutrition Facts table. This category includes fresh herbs such as parsley, basil, thyme, etc. (but not dried herbs); sprouts; and fruits and vegetables that are minimally processed (e.g., washed, peeled, cut up, shredded, etc.), including mixtures of fruits and vegetables, such as bagged mixed salad and coleslaw (without dressing, croutons, bacon bits, etc.). This exemption is lost if any health claim is made, including the following: "A healthy diet rich in a variety of vegetables and fruit may help reduce the risk of some types of cancer."

Fresh fruit and vegetable packaging regulations are also summarized on the Canadian Produce Marketing Association's website at www.cpma.ca/Nutrition/en/labelling.asp.

Labels (or packaging where appropriate) should include information and/or instructions to the next person in the food chain regarding safe handling, display, storage and preparation of the product. For example, a product may require refrigeration or freezing.

## Mock Recalls

**O6.2 Written recall procedures are tested by conducting mock recalls. Mock recalls are effective in determining where a particular product lot/shipment is within a specified time frame. Mock recalls are conducted by trained personnel at a frequency adequate enough to ensure the recall system is up to date and functioning properly.**

Periodic mock recalls assess the readiness of the recall team by testing the capability of rapidly identifying and removing products from the market. By testing written recall procedures, any gaps in reliability and accuracy of records, tracing and trace-back systems, response time, the traceability of contact lists or other problems can be identified and the necessary adjustments made before a real recall takes place.

Mock recalls should be planned, periodic, unannounced and deal with recalling a specific product. They should be conducted at least once a year or when there have been changes to the operation or personnel.

Details and results of mock recalls should be kept on file.

## O7 WATER SAFETY

### Water Treatment Monitoring

**O7.1 Water treatment activities are performed in a way that protects the safety and suitability of food.**

Because of its abundant use during food production, water quality is vital to safe food production.

Potential water (and ice) contaminants may be microbiological, chemical or physical. While all may cause adverse health effects, microbial contamination is generally of greatest concern.

### Microbial

Water may contain enteric pathogens (bacteria, viruses and parasites), which can be transmitted to humans. While bacteria do not multiply in water, many can multiply in food. Viruses and parasites do not reproduce in food.

#### Waterborne Pathogens

| | |
|---|---|
| Bacteria | *Salmonella*, *Shigella*, pathogenic strains of *E. coli* (e.g., O157:H7), *Vibrio*, *Heliobacter*, *Yersinia*, *Campylobacter* |
| Viruses | Noroviruses, Enteroviruses, Hepatitis A, Rotavirus |
| Parasites | *Giardia*, *Crytosporidium*, *Cyclospora*, Amoeba, Toxoplasma, Roundworms, Flatworms, Tapeworms |

Although microbiological testing can detect pathogenic bacteria, viruses and protozoa (parasites), it is not practical or economical to routinely test for all of them. Instead, water (and ice) is examined for groups or species of non-pathogenic, fecal bacteria that are usually present in higher numbers than the pathogens.

### Bacterial Indicators

Coliforms are a group of bacteria that live in the intestinal tract of warm-blooded vertebrates and throughout the environment. They include strains such as *Escherichia*, *Klebsiella*, *Enterobacter* and *Citrobacter*, which are found in human and animal fecal material, soil, untreated environmental waters (rivers, ponds, lakes, etc.), and in insects. Coliform counts are used to indicate the level of hygiene. However, coliform counts are unable to differentiate between fecal and non-fecal contamination.

The presence of coliforms is assumed to result from contamination with fecal material and is used as an indicator of the **possible presence** of enteric (intestinal) pathogens. The absence of fecal indicator bacteria means that pathogenic enteric bacteria are **probably** absent. These bacterial groups or species are called "indicators of enteric pathogens" or simply "indicators."

*Escherichia coli* are the only coliform species that are found exclusively in the intestinal tract of humans and other warm-blooded animals. Animals, including humans, shed *E. coli* through their normal digestive process. There are many serotypes (strains) of *E. coli*. Most are harmless. However, a few are pathogenic, so the presence of any *E. coli* in water is cause for concern. The *E. coli* serotype 0157:H7 is the most widely known and considered the most dangerous in North America.

*E. coli* is the most specific indicator of fecal contamination and the **possible presence** of pathogenic microorganisms in water. If *E. coli* is absent, pathogenic bacteria are **probably** absent. Sources of *E. coli* contamination in water include feedlots, faulty septic systems, barnyards, pastures, rangeland, manure storage facilities and waste lagoons, faulty wastewater treatment plants, wildlife and waterfowl. *Salmonella* can also be found naturally in animals, especially poultry and swine.

There are those who believe that coliforms and *E. coli* are poor indicators of contamination. As a result, new methodologies are being developed. One of these is heterotrophic plate count (HPC), which estimates the number of live heterotrophic bacteria (those requiring organic carbon for growth) in water. In conjunction with other testing, HPCs may be useful in identifying the number and spectrum of waterborne bacteria.

None of these traditional bacterial indicators reliably indicates the presence of protozoa (parasites) or viruses.

**Sampling**

When sampling, it must be remembered that water contamination is often intermittent and pathogens do not always distribute uniformly in water. For this reason, a negative test result does not guarantee the absence of pathogenic bacteria. Frequent testing increases the opportunity to discover contamination, if it is present.

While regular testing of municipal water may appear to be unnecessary, the outbreak at Walkerton proved that municipal water is not always safe. Also, safe water that leaves the treatment plant can become contaminated by the distribution/storage system. For private wells, samples should be collected at times when contamination risk is highest—during spring thaw, after heavy rains, or during dry periods.

The Canadian Food Inspection Agency (CFIA) recommends that municipal water used in food processing should be tested twice a year. Water from other sources should be tested once a month.

Because use of contaminated water can cause severe consequences, many food processors test much more frequently; some as often as every day. Private laboratories perform coliform and *E. coli* water analysis for a fee in the $25 to $30 range. In addition to bacteria, food processors may also wish to test water for metals, minerals and pesticides.

Water samples must be collected in sterile bottles (usually provided by the testing laboratory). Taps or hoses should be allowed to run for at least three minutes before water is collected. Great care must be taken that only water touches the mouth and inside of the collection bottle. A minimum of 100 mm is required for sampling; however, 500 mm should be collected. All necessary information must be attached to the sample.

Sometimes the size of the sample is doubled. Half of the sample is sent for testing and the other half is retained by the sampler for future testing if the first sample tests positive. (See the next section for an explanation.)

Samples should be transported to the laboratory as quickly as possible, preferably in a cooler. No more than 24 hours should elapse between the time of collection and the time testing begins.

Water sampling procedures should be included in a written Standard Operating Procedure (SOP).

## Interpreting Microbial Test Results

Microbiological test results for water samples indicate:

- The number of colony-forming units per 100 ml (CFU/100 ml) of "total coliform" and
- The cfu/100 ml of *E. coli*.

The maximum acceptable concentration for both coliforms and enteric *E. coli* bacteria in water used in food production is zero. If either is detected, immediate resampling must be undertaken. Should food production be allowed to continue, all product should be held until laboratory analysis confirms that the water is safe. If product is shipped and the water is found to be unsafe, a recall of contaminated product may be necessary. If *E. coli* is confirmed, the appropriate agencies (your local health unit) should be notified, the water boiled before use and an investigation undertaken. If consecutive samples determine the presence of coliforms, corrective water treatment should be taken immediately.

Different laboratories have different ways of expressing the number of organisms (coliform or *E. coli)*. Some labs report an absolute number (e.g., 150). Some labs may head their columns "cfu/100 ml" (colony-forming units per 100 ml). In reality, the number reported is really still the number of organisms, albeit expressed in a very confusing manner. For example, the reported number under coliforms may be 1.50E+02. The "E" means exponent (to the power of 10). Therefore the number converts to $1.50 \times 10^2$ or $1.50 \times 10 \times 10$, which equals 150. There are 150 coliforms in 100 ml of water in this example.

Other examples:
$<1.0\text{E}+00 = <1.0 \times 10^0 = <1.0 \times 1 = <1$ organism
$8.5\text{E}+01 = 8.5 \times 10^1 = 8.5 \times 10 = 85$ organisms
$2.0\text{E}+03 = 2.0 \times 10^3 = 2.0 \times 10 \times 10 \times 10 = 2{,}000$ organisms

Test results should be interpreted with caution.

When test results are negative, the results are assumed to be correct. However, **negative test results DO NOT GUARANTEE the absence of pathogens in the water**. Pathogens may be present; they just were not found because they are present in low numbers and not uniformly distributed.

When the water tests positive, the results are also presumed to be correct (a presumptive positive). At this point, there are two options.

Option 1: Agree that the test result is correct and take immediate corrective action.

Option 2: Test the duplicate sample (described above) to confirm that the first result was correct.

The prudent choice is to accept the initial result rather than trying to prove it incorrect.

Keep copies of all sample results. A water testing record will assist in monitoring results and indicate when additional sampling should take place.

**Chemicals**

Chemicals, such as pesticides, synthetic organics, nitrates, arsenic, lead, mercury and asbestos are sometimes found in water. In large enough quantities all are potentially toxic. Chemical contamination can result from chemical spills, incorrect use of pesticides, improper water treatment, or from cross-contamination with sewage or industrial waste.

**Physical**

Physical characteristics of water including colour, odour, taste, temperature and turbidity (cloudiness) are primarily aesthetic and generally pose very small health risks, but may affect food quality.

**Water Standards**

Water quality is a very important element in food safety from the viewpoint of processing and cleaning. All water used in processing and cleaning activities must meet Canadian Drinking Water Quality Standards, meaning that it must be potable. The Summary of Guidelines for Canadian Drinking Water can be found at www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/doc_sup-appui/sum_guide-res_recom/index_e.html.

The Ontario Ministry of the Environment (MOE) website outlines recent changes to Ontario's drinking water regulations at www.ene.gov.on.ca.

**Water Treatment Plan**

Water testing results may indicate that a water treatment program is required. A water treatment plan should include the following elements:

- The water treatment activity to be performed (e.g., UV treatment of well water, wash water chlorination, and filtering/treatment of recycled wash water or flume water).
- The personnel responsible for each of the treatment activities.
- The chemicals/equipment required for each treatment.
- Explicit directions as to how to use the required equipment, including filter, screen, etc., as well as cleaning and maintenance; for chemicals, explicit directions as to proper handling of the chemicals (for personal safety and to prevent or minimize contamination), including the concentration to be used.
- The criteria/schedule for water treatment activities.

- The documentation required.

When water treatment is required, the procedures to follow should be recorded in a written Standard Operating Procedure (SOP).

## Water Treatment Options

An ideal system purifies water to the quality level required for its intended use and, where necessary, provides ongoing residual disinfection after treatment but does not cause chemical contamination of the water. The selection of a system or combination of systems (the multibarrier approach) should be based on the contaminants to be removed, the amount of water used, the initial cost, and ongoing costs of operating and maintaining the system.

### *Chlorine*

Chlorination is the most common method of eliminating disease-causing organisms in water. The effectiveness of chlorine depends on several factors:

- The chlorine demand of the water (e.g., turbidity, organic mater, presence of chemicals such as iron, manganese, hydrogen sulfide, ammonia)
- The concentration of the chlorine solution added
- The time that chlorine is in contact with the organism
- The water temperature
- Water pH.

When chlorine is added to water, a portion of it combines with other dissolved chemicals and plant material in the water and is "used up." Only the remaining chlorine (commonly referred to as "free chlorine," it is mainly hypochlorous acid) is available to destroy pathogenic microorganisms present in the water. Easy-to-use test kits can be used to measure chlorine residual levels. Frequent testing (every one to two hours) will ensure that chlorine concentration is maintained at proper levels.

As noted in the tables below, the water pH level greatly influences the chlorine concentration required for effective disinfection. The "free chlorine" (hypochlorous acid) in solution decreases as pH increases and increases as pH decreases. However, if the pH falls below 4.0, dangerous chlorine gas is produced. The optimum pH for the presence of hypochlorous acid is 6.5 to 7.0. Water pH should be checked when chlorine is added. Although seldom necessary, pH may be adjusted with commercially available buffers, if necessary.

Temperature also affects chlorine effectiveness. Reaction rates double for every 10°C (50°F) increase in temperature, up to 52°C (125°F). However, chlorine is relatively ineffective at temperatures above 46°C. At higher temperatures, dangerous chlorine gas is released.

When chlorine is added to water containing high organic matter content, a group of byproducts known as trihalomethanes (THMs) may be formed. Although risks from these byproducts are apparently small, their presence can be limited by controlling the amount of natural organic material in the water prior to disinfection.

Depending upon the system, either liquid or dry chlorine may be used as a disinfectant. A number of devices may be used to meter chlorine into the system continuously, or chlorine may be added to water held in tanks before use (simple chlorination). Short contact time at high chlorine concentrations (10 ppm) is called superchlorination. It may produce undesirable strong odours. If necessary, these odours can be removed with a carbon filter just before the water is used.

*Cryptosporidium parvum* and *Giardia lamblia* are both resistant to chlorination. However, they may be removed by filtering. Recent scientific studies using ultraviolet radiation and ozone treatment show promise.

### Hydrogen Peroxide

Hydrogen peroxide is a powerful anti-oxidant. However, when compared to chlorine, hydrogen peroxide ($H_2O_2$) is a much less effective disinfectant. It has not been approved as a stand-alone microbial treatment in potable water systems. Hydrogen peroxide is mostly used in combination with other disinfection/sanitation methods to increase its effectiveness. By itself and in combination, hydrogen peroxide is often used for treatment of air, non-potable water, wastewater, soil and sludge.

Hydrogen peroxide is environmentally friendly, decomposing into water and oxygen.

### *Other Chemicals*

Alternatives to chlorine-based disinfectants in drinking water exist. However, some are of questionable value and others create undesirable byproducts in the water.

All water bacterial treatment chemicals used must be included in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* from the CFIA at www.inspection.gc.ca/english/ppc/reference/dppe.shtml.

**Reverse Osmosis** Reverse osmosis (RO) employs a semi-permeable membrane that allows some molecules to pass through but not others. In a reverse osmosis system, high hydraulic pressure forces pure water through a semi-permeable membrane, leaving the contaminants behind. Purified water is collected from the "clear" side of the membrane, and water from the "contaminated" side is flushed down the drain. To remove contaminants from the semi-permeable membrane, water flow is periodically reversed.

RO removes salt (nitrites) and other inorganic material, as well as microscopic parasites and many bacteria. Experiments by General Electric scientists measured a 4-log (99.99 per cent) reduction of bacteria. While this bacterial removal rate may seem impressive, it is seldom great enough to meet potable water standards. When it is not, further water treatment is required.

Generally, RO systems are relatively slow, require membrane maintenance and have a significant capital cost. Any defect in the membrane allows contaminants to pass through. Membranes must be periodically cleaned and/or replaced. There can be large volumes of water wasted in RO systems. Depending upon the type and configuration of the system, the water rejection rate (water down the drain) can be 3 to 10 litres of water for every litre produced.

**Filters** The size of the openings in filters is measured in microns. One million microns equals one metre. A human hair is about 100 microns in diameter. A rod-shaped *E. coli* bacteria is 1.0 to 1.5 microns in diameter and 2 to 6 microns long. A *Salmonella typhi* bacteria, which is also rod shaped, is 0.4 to 0.6 microns in diameter and 2 to 3 microns in length. Round *Cryptosporidium* cysts (a parasite) are 4 to 6 microns in diameter.

There are two types of filters, sediment (made of fibres or ceramic) and activated carbon. Sometimes the two types are combined into one unit. Filtration efficiency is classified as either "absolute" or "nominal." An *Absolute Filter Rating* means that 99.9 per cent of the particles larger than a specified micron rating will be trapped on or within the filter. A *Nominal*

*Filter Rating* indicates that the filter will retain 85 per cent of the particles of the size equal to the nominal filter rating.

Fine pore sediment filters (1 micron or smaller) will remove *Cryptosporidium* cysts and some bacteria, as well as physical particles. No filter will remove dissolved lead, mercury, trihalomethanes or other organic compounds. Viruses cannot be removed by any filtration method. The finer the filter pore, the more it traps, but the more often the filter must be changed.

Carbon is a powerful adsorbent. Activated carbon filters consist of carbon particles that have been heat-treated to increase their surface area. One gram of activated carbon has a surface area of 600 to 1,000 sq. m and can adsorb thousands of different chemicals.

Solid Block Activated Carbon (SBAC) filters use compressed carbon granules with an effective pore size of 0.5 to 1 micron. They are very effective in removing bacteria, chemicals, and particulate material by mechanical straining and adsorption. Granular Activated Carbon (GAC) filters have fairly large carbon granules and relatively large (20 to 30 microns) pores, so straining and adsorption of impurities and bacteria may not be complete. It must be remembered that the capacity of carbon to adsorb contaminants is finite. Once the carbon surface is covered, its adsorption capacity is exhausted and the carbon (or entire filter) must be replaced.

### *Ultraviolet (UV) Light*

Water passes through a clear chamber where it is exposed to ultraviolet light generated by mercury arc lamps. It is a non-chemical sanitizer.

UV radiation kills bacteria, most viruses (not retroviruses and rotaviruses), spores, and cysts (*Cryptosporidium)* by penetrating cell walls and damaging genetic material. It has no effect on lead, asbestos, organic chemicals or chlorine. Cloudy or turbid water reduces UV effectiveness. UV radiation has no residual disinfection effect but forms no known byproducts at levels of concern.

High capital costs and high maintenance costs are generally associated with UV equipment. Water clarity, hard water scaling on UV tubes and biological fouling of the UV tube can compromise disinfecting action. UV lights must be used only in covered in-line applications. Eye exposure to UV radiation can cause permanent eye damage.

### *Ozonation*

An ozone molecule contains three oxygen atoms ($O_3$) instead of the two atoms ($O_2$) found in a normal oxygen molecule. Ozone occurs naturally through lightning and when ultraviolet rays of the sun react with the Earth's upper atmosphere. Ozone may also be generated on-site in several ways including by passing dry oxygen or air through a system of high-voltage electrodes.

Ozone is a powerful oxidant and sanitizer. It kills bacteria, parasites, and mould and yeast spores by oxidation. It is an excellent virucide. Its high reactivity and low solubility make it difficult to apply and control.

While ozonation produces no chlorinated byproducts (THMs), it does form brominated byproducts (bromate, brominated organics) and non-halogenated byproducts (ketenes, organic acids, aldehydes). Ozone breaks down complex organic matter into small compounds that increase nutrients in water supplies and enhance microbial regrowth in water distribution systems. It provides no residual disinfection.

While ozonation has been successfully used, ozone generators are costly, complicated, and require a high level of technical competence to operate and maintain. However, new technology improvements show promise in both water sanitation and direct food contact applications.

## Wash Water

Spray or flume washing is often used to reduce surface populations of microorganisms. Wash water antimicrobial agents serve two purposes: they kill spoilage organisms and/or pathogens washed off fruit or vegetables and prevent the wash water from becoming a reservoir of spoilage organisms and/or pathogens that can contaminate previously uncontaminated produce. Studies indicate that failure to maintain an adequate level of sanitizer in wash water can actually lead to increased microbial populations on produce.

Wash water sanitation is a unique challenge due to the heavy organic/soil load often carried by the water.

### Chlorine

Chlorine is a powerful oxidant but does not discriminate in its reactions. Therefore, the higher the level of organic matter/soil in the wash water, the higher the level of reaction, and the faster the chlorine is "used up" and loses its effectiveness.

To maintain proper chlorine levels, a regular monitoring schedule is necessary for both chlorine and pH. Chemically impregnated paper strips may be used for both. Chlorine is most effective at a pH between 6.5 and 7.0. The optimum chlorine concentration varies with the produce being washed and the method of application (spray or flume) to the fruit or vegetable. It may be as low as 50 ppm (for radishes) or as high as 400 ppm (for bell peppers). Check for the optimum chlorine level for your particular fruit or vegetable before chlorinating wash water.

In smaller operations, filtering water to remove soil, leaves, and other debris and/or changing water often is the most effective way to maintain water cleanliness and chlorine's sanitation efficacy. Larger operations may opt for systems that continuously test water and automatically maintain chlorine levels.

### Peroxyacetic Acid

Peroxyacetic acid may be used as an antimicrobial agent in fresh-cut, further processed, and post-harvest fruit and vegetable flume and wash water systems. In contrast to chlorine, it has low reactivity with organic matter, so it is more effective where high organic matter is present. Because antimicrobial activity remains active at temperatures as low as 4°C it may be used in conjunction with hydrocoolers and other water cooling equipment. Microbial control is most effective at acid to slightly alkaline pH. It is typically sold as a 5 per cent or 15 per cent active solution.

Some formulations of peroxyacetic acid may be used as a fruit and vegetable spray or dip to control microbial growth that causes decay or spoilage on the surface of produce.

Compared to chlorine, peroxyacetic acid reduces corrosion rates and other chemical-caused damage to equipment. It is environmentally friendly, breaking down to acetic acid (vinegar), water, oxygen and carbon dioxide. However, it has a pungent odour, is costly and has a relatively short shelf life.

### Wash Water Filtration

**Generally, the use of recirculated water is not recommended for washing fruits and vegetables because of the accumulation of organic matter and microorganisms.** However, in some circumstances, lack of an adequate water supply may necessitate reuse of all or a portion of the wash water.

A "multiple barriers" approach is generally the best method for treatment of wash water. The number of barriers depends upon the organic matter and/or soil content (turbidity) level of the water. For example, at very high levels, a treatment system might include a settling pond, followed by slow sand filtration, followed by carbon filtration, followed by chlorination.

Water treatment may include chemically caused coagulation, flocculation or sedimentation in a settling pond. Roughing filters consist of gravel and/or sand segments that trap solids in the pores between the media particles. A slow sand filter is basically a box (or cylinder) full of "sand" (manufactured, gap-graded, silica media) with an underdrain at the bottom. Water is diffused evenly on the sand surface. Bacteria, viruses, organic matter, silt, clay, and other particulate matter accumulate in the top layers of the sand and on the sand surface, forming a biological layer. The biological layer greatly increases filter effectiveness but eventually accumulates to a thickness that impedes water flow. At this point, the biological layer (or schmutzdecke) must be scraped off. Following cleaning, the process begins again.

Following removal of large particulate matter by a sand filter, Granular Activated Carbon (GAC) or Solid Block Activated Carbon (SBAC) filters may be used to filter out remaining particulate matter and to adsorb dissolved organic matter and other contaminants. However, once the adsorption capacity of a carbon filter is reached, the carbon must be replaced in order for the filter to remain functional.

Once organic matter and turbidity have been largely removed from the wash water, chlorine can be added with some assurance that it will be effective as a sanitizer. As noted earlier in this section, water pH, water temperature, the level of chlorine concentration and contact time also affect chlorine performance.

Only chemicals included in the *Water Treatment Compounds* section of the CFIA's Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products at www.inspection.gc.ca/english/ppc/reference/t1e.shtml should be used for water treatment. Note that there is a subsection listing acceptable chemicals that "may come in contact with food products" and another for chemicals that "will not come in contact with food products."

**Stored Water**

All water containers must be covered.

As with recycling systems, water storage containers must also be cleaned and sanitized periodically so they do not become a source of contamination.

Every processor should have a contingency plan in place to deal with unsatisfactory water. That plan may include on-site treatment, trucking in water of satisfactory quality, or, if necessary, ceasing operations until the water quality returns to acceptable standards.

As with all other activities in the processing environment, adequate training should be provided to those performing these activities.

**Water Safety Monitoring**

**O7.2 Water safety monitoring activities are performed in a way that protects the safety and suitability of food.**

To ensure that the water treatment plan is being implemented and to monitor its effectiveness in maintaining potable water, a water monitoring plan is also necessary.

A water monitoring plan should include the following:

- A list of the water samples to be collected and the schedule for collecting them. Some samples may be for in-house testing (e.g., chlorine levels in wash water) and some may be tested externally (e.g., for fecal coliforms).
- A detailed description of the water sample collection and sample submission procedures. If testing is done in-house, the testing procedures must also be described, including the equipment and chemicals to be used.
- The personnel responsible for each task.
- Documentation requirements for each sample (e.g., date of sampling, water source, sample site, analytical result, analyst (in-house person or external accredited laboratory).

- The actions to be taken when the water analysis does not meet predetermined criteria (e.g., add more chlorine, shut down the production line if *E. coli* is discovered, recall product, etc.)

A monitoring plan should not be a static document. It should be reviewed for completeness, accuracy and suitability to changing circumstances within the processing environment.

## P1 CONTROL PROGRAMS

**Control programs are developed and updated as required. Each program outlines effective food hygiene policies and procedures to protect the safety and suitability of food. Each program outlines the roles, responsibilities and instructions for each operational area.**

Good Manufacturing Practices (GMPs) are the basic, universal conditions and procedures within the processing establishment that create conditions favourable for the production of safe food. They are the sum of all the programs/policies, practices and procedures that must be applied to reduce contamination risk during food processing.

**What Is Required?** Every facility should develop **written** policies and procedures for:

- Each specific operational area of:
    - **O1** personnel practices
    - **O2** shipping, receiving, handling and storage
    - **O3** sanitation
    - **O4** equipment maintenance
    - **O5** pest control
    - **O6** recall
    - **O7** water safety
- All food safety–related employee training, as well as specialized technical training for areas such as sanitation, calibration, etc.

Training is addressed in the next section of this Guidebook.

Each written control program should describe the GMP programs/policies and procedures necessary to protect the safety and suitability of food. As an added benefit, detailed procedural and training descriptions help workers to quickly grasp the details of new or temporary assignments by following the written "recipe."

**Operational Controls** Operational control written programs should meet required GMP standards and be suitable for your operations. Those that aren't should be revised until they are. Programs should also include a monitoring component to ensure that the required GMP standards are being met.

These written programs are sometimes referred to as Standard Operating Procedures (SOPs) or Sanitation Standard Operating Procedures (SSOPs). An example of each follows in this section.

Records offer written proof both that GMP programs are being followed and those operational processes are under control, thus reducing the probability of contamination. They are your "due diligence." Records also create an investigative mechanism to determine the cause (e.g., the program has not been followed) or to rule out the cause (e.g., the program has been followed) of food safety problems, should they occur.

## Environmental Controls

Environmental controls outline requirements of the establishment location, design and equipment necessary to create a physical setting conducive to the production of safe food. Because they are not related to people or the actions of people, they cannot be addressed by a written procedural program.

Redesign, repairs or replacement of buildings and/or equipment can generally correct deficiencies in environmental controls. In the absence of long-term solutions, interim controls may be used to control a hazard for the short term. For example, an employee may use a squeegee to eliminate pooled water from a poorly drained area. This short-term solution may eventually prove to be less effective and more costly than repairing the floor.

## Standard Operating Procedures (SOPs)

Standard Operating Procedures (SOPs) are written descriptions of specific tasks in your food processing facility that may or may not be related to food safety. Each SOP should include GMP criteria.

In clear, concise and complete terms, a SOP should address:

- The purpose of a task
- Its frequency
- The job position assigned to perform the task
- The equipment and chemicals required to perform the task
- A step-by-step description of the procedure that includes all the steps involved, their sequence and the corrective action to be taken if pre-determined standards are not achieved
- The records required to document procedures, monitoring and any corrective action taken.

It is important that the procedure described makes it easy to perform the task correctly. If the procedure is difficult to understand, the likelihood that the task will be consistently done well is significantly reduced.

Too often, SOPs are written by "experts" who know how the procedure should be done but fail to consult with those supervising or performing the procedure to discover how the procedure is currently being performed and the capabilities of the existing system and its workers. Therefore, an ideal SOP preparation team includes technical experts, supervisory staff and the people who actually do the work. Together, this team should be able to create a plan that is compatible with other plant operations, is workable and meets food safety requirements.

Programs should not be static. As conditions change, as more efficient procedures are discovered, as the equipment and materials used change, as formulations are altered, etc., the SOP must reflect these improvements as the "current best approach." For this reason, the SOP team should meet on a regular basis to review and update the SOP.

A single SOP need not cover every aspect of each operation. It may be divided into components to make it more manageable. For example, while personnel practices, as a group, relate to personal hygiene, a single SOP covering all areas of personal hygiene might be difficult for workers to understand and follow.

Every SOP should contain enough detail that an employee will know exactly what to do simply by following the written instructions. Each SOP should answer the questions, who? what? where? when? and why?

**SOP Example** This is an example of a handwashing SOP.

Policy: *[describes the standard]*

All those handling food, ingredients, packaging materials and/or touching food contact surfaces must wash their hands and put on clean gloves before beginning their assigned tasks. There will be no exceptions.

Responsibility: *[indicates who is responsible for performing the procedure]*

All those handling food, ingredients, packaging materials and/or touching food contact surfaces.

Frequency: *[indicates how often the procedure will be performed]*

Hands must always be washed and clean gloves put on:

- Immediately before handling food, ingredients, packaging materials and/or touching food contact surfaces
- After using the toilet
- After coughing, sneezing, blowing or wiping the nose, or touching hair or the face
- After each absence from the work station for coffee breaks and eating
- After handling incompatible food products, raw materials, or potentially hazardous materials such as garbage or cleaning chemicals
- After picking up objects off the floor
- Any other time hands become soiled or contaminated.

Procedure: *[describes the specific procedures required to meet the standard]*

- Roll up sleeves far enough so that wrists are exposed and sleeves do not get wet during washing.
- Wet hands and wrists under warm water (38–43°C).
- Apply 3 ml of antimicrobial soap.
- Scrub hands palm to palm. Scrub in between and around fingers. Scrub back of each hand with palm of other hand. Scrub fingertips of each hand in opposite palm. Scrub each hand clasped in opposite hand. Scrub each wrist clasped in opposite hand. Scrubbing must last for a minimum of 15 seconds.
- Rinse hands and wrists thoroughly under warm running water.
- Dry hands well with a single-use paper towel.
- Turn off water tap using the paper towel.
- Put on gloves.
- If gloves have been worn previously, they must also be washed before beginning or returning to their assigned tasks.

Monitoring: *[indicates who is responsible for ensuring that the standards are met]*

Supervisors will monitor hand and glove cleanliness.

Corrective Actions: *[indicates action required to meet standards if they are not met initially]*

When hands and/or gloves do not meet policy criteria, the responsible supervisor will direct the offender to wash again. The supervisor will perform a follow-up inspection.

Corrective actions will be recorded on the Employee Sanitation Report.

Applicable Records: *[a record of what took place. "If you don't write it down, it didn't happen."]*

Employee Sanitation Report (fictional, for purposes of this example)

## Sanitation Standard Operating Procedures (SSOPs)

SOPs related to sanitation are called Sanitation Standard Operating Procedures (SSOPs). An SSOP should be specific enough that the sanitation crew can complete each cleaning and sanitation activity simply by following the written instructions. This means that cleaning and sanitation activities will be carried out at the right time and in the right place by using the proper procedures with the right chemicals at the right concentrations.

SSOPs should:

- Identify the building areas, equipment, and utensils to be cleaned and sanitized
- Indicate the frequency of cleaning and sanitation for each building area, each piece of equipment and each utensil
- Prescribe the procedures for cleaning and sanitizing
- Specify the chemicals to be used, their concentrations, and the temperature of the cleaning or sanitizing solution
- Designate the job position responsible for each cleaning and/or sanitizing task
- Set a procedure to verify that the cleaning and sanitizing has been effective
- Indicate the record keeping required.

**SSOP Example** This is an example of a washroom SSOP.

Policy: *[describes the area and the expected standard]*

All washrooms have an adequate supply of hot and cold potable running water, soap dispensers, liquid soap, single-use paper towels and cleanable garbage containers. Walls, floors, ceilings and bathroom equipment are clean and sanitary. Floors are free of standing water. Sanitary facilities, exhaust fans, floor drains, soap dispensers, doors and other equipment are in working order.

Signs (in English, French and Spanish) directing food handlers to wash their hands are posted, along with signs indicating proper handwashing technique.

Frequency: *[indicates how often the procedure will be performed]*

Food handler washrooms will be cleaned after each employee break (after workday begins, after mid-morning break, after lunch break, after mid-afternoon break, and after food handlers have left the facility following their shift).

Procedure: *[describes the specific procedures required to meet the standard]*

Washrooms will be visually inspected to ensure there are adequate supplies of liquid soap and single-use paper towels, that there is an adequate supply of hot and cold potable running water, that all equipment is in working order and otherwise in good repair, and that handwashing signs are posted and readable. Supplies will be refilled, as required.

Sanitary facilities, including toilets, urinals, sinks, etc., in food handler washrooms will be cleaned and sanitized at least twice per day using cleaning and sanitizing agents designated by the Sanitation Supervisor. Cleaning and sanitation may be more frequent, as determined by the Sanitation Supervisor.

Garbage containers will be emptied and cleaned after each break.

Walls in food handler washrooms will be cleaned and sanitized once per day or more frequently, if necessary.

Required repairs to equipment or structures will be noted in the Daily Sanitation Log and a written Work Order forwarded to the Maintenance Department immediately.

Chemicals: *[the chemicals used, the concentrations, the temperatures]*

- Cleaner XXX mixed at 1 L of chemical per 20 L of 25–40°C water
- Sanitizer YYY mixed at 500 g of chemical per 40 L of 25–35°C water.

The times, activities and chemical agents used will be recorded in the Daily Sanitation Log.

Responsibility: *[indicates job position responsible for performing each task]*

A member or members of the Sanitation Department designated by the Sanitation Supervisor will be responsible for performing cleaning and sanitation functions in all food handler washrooms.

Monitoring: *[indicates who is responsible for ensuring that the standards are met]*
The Sanitation Supervisor will inspect each washroom three times per day.

If policy criteria are not met, the Sanitation Supervisor will direct a member of the Sanitation Department as to the corrective actions to be undertaken to bring the washroom(s) up to required standard.

The Sanitation Supervisor will perform a follow-up inspection.

Corrective actions will be recorded on the Daily Sanitation Report.

Applicable Records: *[a record of what took place. "If you don't write it down, it didn't happen."]*

Daily Sanitation Report (fictional, for purposes of this example)

**Master Sanitation Schedule**

To ensure that no tasks are missed, a Master Sanitation Schedule outlines the frequency with which each sanitation task is performed (e.g., daily, weekly, monthly, end of season).

**Records** To verify that cleaning and sanitation activities have been carried out as described, monitor activities and record results. If monitoring discovers deficiencies between the written SSOP and its implementation, take the predetermined corrective action and record the results. If necessary, alter the procedure or retrain staff to ensure that the deviation does not happen again.

# T1 TRAINING PROGRAMS

**Training is delivered and updated as required to ensure that personnel understand and are competent in the procedures necessary to protect the safety and suitability of food. Training is delivered at an adequate frequency to ensure personnel understanding remains current.**

**Employee Training** The individual contribution of everyone in the plant is essential to the overall success of any food safety program.

Job-specific training is the process by which workers are:

- Made aware of why correct completion of their individual tasks is so important to food safety
- Informed of their individual roles and responsibilities
- Instructed how to carry out those tasks correctly.

Begin training by emphasizing the relationship between employee tasks and the hazards that can cause foodborne illness. This may include an overview of biological, chemical and physical hazards associated with the food being packed/processed. Employees must be able to easily connect the relevance of what is being presented to the jobs they are being asked to do.

For example, each piece of equipment and/or sanitation task should have a comprehensive, but simply stated, list of procedures that must be followed for cleaning, sanitation, and inspection of walls, equipment, food contact surfaces, utensils and floors (an SSOP). Training should review these procedures as they relate to the employees being trained. Throughout the training, employees should understand that their contribution to the cleaning and sanitation program is critical to the safety of the food product.

Training should also include proper mixing, use, handling, and storage of cleaning and sanitation chemicals; use of personal protective equipment (PPE); and where to find and how to read Material Safety Data Sheets (MSDS).

Explain how to complete required documentation and its importance to food safety.

Each employee must have easy access to all written SSOPs that are applicable to his or her roles and responsibilities.

Training must not be restricted to new employees. Established employees, including managers and supervisors, should also receive ongoing training at least annually or when there are changes to the cleaning and sanitation procedures. It is important that backup personnel also receive the same training for tasks they might be required to perform on a fill-in basis.

## Training Delivery

For training to be credible to employees, it should be delivered by qualified individuals who have practical experience in cleaning and sanitation. Trainers should also be able to relate their knowledge/experience to the specific learning needs of individual trainees.

Adults learn best when the learning approach is participatory, problem-centred and relevant to their immediate circumstance. Skills and information that are immediately applicable to the job are most often remembered. Encourage active participation in training sessions by drawing on the trainee's experience. Respectfully listen and respond to trainees' questions and concerns.

Use a variety of teaching strategies to accommodate different learning preferences. For example:

- Visual—illustrations, drawings or designs; video presentations or pictures showing examples of "good" and "bad" practices; colour codes to highlight information; printed materials (e.g., copies of SSOPs, handouts, copies of presentations); wall charts; notes
- Auditory—verbal presentations such as lectures, presentations or oral reports; group discussions; verbal exchanges; real-life scenarios; one-on-one instruction
- Tactile—hands-on demonstrations; hands-on experience to learn a task; trying new things without a lengthy explanation; application exercises.

Restrict training sessions to one or two concepts per session. Several shorter sessions are much easier than one long session where employees cannot possibly absorb all the information presented. Reinforce points. Give positive feedback whenever possible. At the next session, review topics from the most recent session, and discuss how what was learned has been put into practice and what barriers have been encountered.

Each presentation should be in a language understood by the employee.

Symbols and pictures can help overcome language barriers.

The physical environment in which instruction takes place can also affect learning positively or negatively. Take into consideration the room temperature, the arrangement of the room, the time of day, the brightness of the room, the noise level and potential distractions.

In the workplace, reinforce what has been taught with posters, signs and other visual aids placed in strategic, high-traffic locations. Managers and supervisors should also encourage trainees to put into practice what they have learned, offer encouragement for what is done correctly and patiently correct what has been done incorrectly.

**Records** All GMP training must be recorded. Records should include:

- The name of the trainee
- Trainee acknowledgment of the training by initials or signature
- The content of the training
- The date of the training
- The name of the trainer.

# ENVIRONMENTAL ASSESSMENT

## E1 Establishment Location and Construction

(5 - full compliance → 1 - non-compliance) n/a - not applicable

5 4 3 2 1 n/a

| E1.1 Property and Surroundings | Rating | Comments |
|---|---|---|
| 1 Grounds, roads and parking lots have adequate drainage to prevent standing water, which can provide a feeding and/or breeding area for pests, become a source of traffic-borne contamination and seep into the facility. | | |
| 2 To discourage pest breeding and harbourage, supplies and equipment are neatly stored on plant grounds at least 7 metres from the buildings and at least 15 centimetres above the ground. Pipes within 7 metres of the building are capped. | | |
| 3 Grounds, roads and parking lots are free of garbage and litter, and vegetation is cut at least 7 m from the building to minimize harbourage areas for pests. There is a 1-m wide trash-free, vegetation-free gravel or concrete strip. around the perimeter of the building to discourage pest travel. | | |
| 4 Litter and waste are stored in enclosed containers. Waste is removed from the premises at appropriate intervals and in a manner that prevents spillage and litter. The dumpster area is cleaned regularly and is clear of debris and spilled waste. | | |

5 4 3 2 1 n/a

| E1.2 Building Exterior | Rating | Comments |
|---|---|---|
| 1 Plant buildings and roofs are constructed of weather-resistant materials and are structurally sound so there is no entry of outdoor elements (rain, snow) or airborne contaminants (dust, smoke, odours). | | |
| 2 Exterior design discourages pest harbourage by eliminating ledges, nooks and crannies, etc. Cracks and crevices have been sealed to prevent entry of pests. Doors and windows are closed or screened and tight (openings less the thickness of a lead pencil). Outside drain openings are screened. | | |
| 3 Dock doors are tight and closed to discourage pest entry. Leveller plates are tight or are equipped with brush seals. There are no areas suitable for bird roosting or nesting. Dock areas are free of debris and spills. | | |

| | | |
|---|---|---|
| E1 Possible Points | 35 | |
| Actual Points | | |
| Percentage | | |

## E2 Establishment Design

(5 - full compliance → 1 - non-compliance) n/a - not applicable

5 4 3 2 1 n/a

| E2.1 Cross-Contamination Control | Rating | Comments |
|---|---|---|
| 1 Incompatible activities are physically separated (by walls or designated areas) or operationally separated (by scheduling or dedicated equipment) to minimize the potential for cross-contamination of ingredients, food contact surfaces, packaging materials and finished products. | | |
| 2 Traffic patterns of workers and equipment are designed and controlled to minimize travel in areas other than their designated work area. | | |
| 3 Ingredient and product flow is straight through the facility without backtracking and crossover that can cause cross-contamination. | | |
| 4 Aisles are unobstructed, and there is adequate space to permit employees to perform their duties, including cleaning and sanitation, with minimum potential for cross-contamination. | | |

5 4 3 2 1 n/a

| E2.2 Personnel Facilities | Rating | Comments |
|---|---|---|
| 1 Washrooms, change rooms and lunchrooms are constructed of durable, easily cleanable materials; are equipped with proper ventilation; have self-closing doors, adequate lighting, waste receptacles, and functioning drains; and and are free of standing water. Each is separated from, and does not open directly into, food processing areas. None contains plant-use garments. All are in clean and sanitary condition. | | |
| 2 Washrooms have an adequate number of sinks and toilets, hot and cold running water, "hands-free" tap controls, single-use towel dispensers, and liquid handwashing soap. Handwash signage is posted in appropriate languages. | | |
| **E2** Possible Points | 30 | |
| Actual Points | | |
| Percentage | | |

## E3 Establishment Interior

(5 - full compliance ➔ 1 - non-compliance) n/a - not applicable

| | 5 4 3 2 1 n/a | |
|---|---|---|
| **E3.1 Internal Structures and Fittings** | **Rating** | **Comments** |
| 1 Floors are constructed of smooth, non-absorbent, non-toxic, smooth material; have functioning drains; and are free of standing water. They are clean, sanitary and in good repair. | | |
| 2 Walls are constructed of non-absorbent, non-toxic, smooth, corrosion-resistant material to a height appropriate to the operation. They are clean, sanitary and in good repair. | | |
| 3 Full ceilings are easily cleanable and free of loose particles and condensation. Ladders, platforms, walkways, piping, etc. over exposed product lines are appropriately protected (e.g., kick plates on raised walkways) to prevent potential contamination. | | |

| | 5 4 3 2 1 n/a | |
|---|---|---|
| **E3.2 Lighting** | **Rating** | **Comments** |
| 1 The intensity and quality of lighting is adequate in all areas of the facility including receiving, inspection, storage, processing, and shipping, as well as in worker washrooms, change rooms and lunchrooms. | | |

| | 5 4 3 2 1 n/a | |
|---|---|---|
| **E3.3 Lighting Fixtures** | **Rating** | **Comments** |
| 1 All lights in receiving, shipping, production, and storage areas are securely fastened to the ceiling, shielded or protected against breakage, and clean. | | |

| | 5 4 3 2 1 n/a | |
|---|---|---|
| **E3.4 Air Quality and Ventilation** | **Rating** | **Comments** |
| 1 Ventilation adequately removes excessive heat, steam, vapours, odours, dust and condensation. Air intakes are fitted with tight-fitting screens or filters. Fans, air ducts, and other ventilation equipment are clean and well maintained. | | |

| E3.5 Drainage and Sewage Systems | Rating | Comments |
|---|---|---|
| 1 The sewage and plant effluent systems are not interconnected to reduce the potential for plant contamination by sewage backup. No sewage or effluent lines pass through or over production areas unless well protected. | | |
| **E3** Possible Points | 35 | |
| Actual Points | | |
| Percentage | | |

## E4 Equipment

**(5 - full compliance → 1 - non-compliance) n/a - not applicable**

**5 4 3 2 1 n/a**

| E4.1 Equipment Design, Construction and Installation | Rating | Comments |
|---|---|---|
| 1 Equipment and utensils are designed, constructed and installed to perform an intended function and are being used to perform their intended task. There is sufficient distance between equipment (45 cm), between equipment and walls (75 cm), and equipment and floors (20 cm) to facilitate cleaning, sanitation, inspection and maintenance. Utility installations, cabinets, control panels, etc. are mounted 2.5-5 cm. from walls for ease of cleaning and have sloped tops | | |
| 2 Food contact surfaces are non-toxic, non-reactive, non-absorbent, smooth, corrosion resistant, easily cleanable, and able to withstand their processing environment and repeated cleaning. Welds are continuous and smooth. There are no overlap, stitch or spot welds. Fasteners are free of soil traps, dead spaces and metal-to-metal contact. There are no loose nuts, bolts, rivets, or washers, and no exposed threads. Support structures are round or set diagonally and capped. Equipment is free of roll-under edges, recesses, open seams, gaps, protruding edges, dead ends, and dead spaces that can trap food residues. Equipment is constructed so that all parts are easily accessible for cleaning. There are no metal-to-metal moving parts that can create physical contaminants. Belting material, belt pulleys and accessories can be easily cleaned. There is no evidence of flaking paint, rust or mould. | | |

|  |  |  |
|---|---|---|
| 3 Motors, gearboxes, drives, etc. are mounted a sufficient distance below or beside food contact surfaces (30 cm). Where they are not, adequate protection (e.g., drip pans under motors, shielding surrounding drives) is in place to prevent against contamination. Motors, gearboxes, drives, bearings, control panels, etc. are able to stand wash/sanitizing procedures (wash down duty or protected). Operating controls are easily accessible. |  |  |
| 4 Air compressor units are oil-free and air lines have an adequate number of moisture traps and filters. |  |  |
| 5 Cooling equipment is properly sized to provide adequate time/temperature control. |  |  |

5 4 3 2 1 n/a

| **E4.2 Waste Containers and Utensils** | **Rating** | **Comments** |
|---|---|---|
| 1 Waste containers are clearly identified for their intended use, leak-proof, waterproof and covered. None are overflowing. Containers are cleaned before use. |  |  |
| 2 To reduce the risk of cross-contamination, utensils are identified for their intended use and kept separate from equipment and other utensils with other intended uses. |  |  |

5 4 3 2 1 n/a

| **E4.3 Handwashing Stations** | **Rating** | **Comments** |
|---|---|---|
| 1 There are an adequate number of appropriately located handwashing stations. Each has hands-free operation and is supplied with soap, warm water, and disposable paper towels or a suitable drying device. Signs in appropriate languages remind employees to wash and sanitize their hands when they become soiled or contaminated. |  |  |
| **E4** Possible Points | 30 |  |
| Actual Points |  |  |
| Percentage |  |  |

## E5 Water Safety

5 4 3 2 1 n/a

| E5.1 Adequate Supply and Protection of Water, Ice and Steam | Rating | Comments |
|---|---|---|
| 1 Water used in processing and cleaning activities meets potable water standards. Where required, water treatment systems are in place. | | |
| 2 Potable water lines and hoses are fitted with backflow devices to protect against potential cross-contamination. There are no hoses lying on the floor where they can impede drainage and trap water-borne contaminants. | | |
| 3 The potable water system is separate from other systems and clearly marked as such. Recycled/recirculated and/or wash water systems are clearly defined and separated from other water systems. | | |
| **E5** Possible Points | 15 | |
| Actual Points | | |
| Percentage | | |

# OPERATIONAL ASSESSMENT

## O1 Good Manufacturing Practices

(5 - full compliance ➔ 1 - non-compliance) n/a - not applicable

5 4 3 2 1 n/a

| O1.1 Personal Practices | Rating | Comments |
|---|---|---|
| [1] Food handlers maintain a high degree of personal cleanliness and hygiene (e.g., clean skin and hair, no cosmetics or perfumes, no beauty aids). | | |
| [2] Food handlers do not wear jewelry or other unsecured personal objects that could fall into food. Hand jewelry that cannot be removed is securely covered with sanitary material (e.g., gloves). | | |
| [3] Food handlers refrain from using tobacco, chewing gum, eating, drinking, sneezing, coughing, spitting or other unhygienic activities. They are not observed touching their nose or mouth. | | |

5 4 3 2 1 n/a

| O1.2 Hand Washing | Rating | Comments |
|---|---|---|
| [1] Food handlers are observed washing their hands immediately before handling food, ingredients, packaging materials, and/or touching food contact surfaces; after using the toilet; after coughing, sneezing, blowing or wiping the nose, or touching hair or the face; after each absence from the work station for coffee breaks and eating; after handling incompatible food products, raw materials, or potentially hazardous materials such as garbage or cleaning chemicals; after picking up objects off the floor; and any other time hands become soiled or contaminated. | | |
| [2] Gloves are worn where there is direct hand contact with ingredients or product. They are maintained intact, clean and good condition. | | |
| [3] Disposable gloves are replaced when they become ripped or cut, following contamination by coughing or sneezing, after touching any non-food contact surface, after any absence from the workstation, whenever tasks change, or when potential contaminates are handled. Non-disposable rubber gloves are washed and sanitized following each of the same circumstances. | | |

|  | 5 4 3 2 1 n/a |  |
|---|---|---|
| **O1.3 Clothing, Footwear and Headwear** | **Rating** | **Comments** |
| 1 Hairnets and beard and mustache restraints are properly worn in food processing, handling and other designated areas. |  |  |
| 2 Employee clothing and shoes are clean and sanitary and do not contribute to potential product contamination. Protective garments (aprons, smocks, etc.) are also clean and suitable to the operation, and do not contribute to potential product contamination. Objects such as pens, thermometers, tools, etc. are not carried in above-the-waist pockets where they might fall into food, equipment or containers. |  |  |
| 3 Protective garments are removed before entering a washroom, lunchroom, or change room, and are not worn outside the facility. When appropriate, to prevent potential cross-contamination, protective garments are changed as employees move between different processing areas. Employees adhere to designated traffic areas when moving through the facility. |  |  |

|  | 5 4 3 2 1 n/a |  |
|---|---|---|
| **O1.4 Storage – Clothing, Equipment and Utensils** | **Rating** | **Comments** |
| 1 Employees' personal items are stored in areas separate from processing, storage, and shipping and receiving areas. These storage areas are kept clean and well maintained. |  |  |
| 2 Specific-use equipment and utensils are clearly marked and stored in defined areas where they will not be contaminated by processing or cleaning activities. |  |  |

|  | 5 4 3 2 1 n/a |  |
|---|---|---|
| **O1.5 Injuries and Wounds** | **Rating** | **Comments** |
| 1 Employees with open sores or infected wounds are not allowed to have direct contact with food, ingredients, packaging materials or food contact surfaces. |  |  |

5 4 3 2 1 n/a

| O1.6 Evidence of Illness | Rating | Comments |
|---|---|---|
| 1 High health risk employment candidates (those with communicable disease and/or infections) are identified at the time of hiring. Such candidates are not suitable for work in a food handling environment. | | |
| 2 Employees with discharges from the nose, ears, and eyes, or who are coughing and sneezing are not allowed to have direct contact with food, ingredients, packaging materials or food contact surfaces. | | |

5 4 3 2 1 n/a

| O1.7 Access and Traffic Patterns | Rating | Comments |
|---|---|---|
| 1 Measures are in place to restrict access to the facility to authorized personnel only (e.g., physically or electronically monitored). Specific areas of access are clearly defined for personnel who are not escorted (e.g., truck drivers, outside contractors). All other facility visitors are escorted by plant personnel at all times. | | |
| 2 Within the facility, easily identifiable food handlers and others are restricted to specific traffic and work areas. No personnel are found in unauthorized areas. | | |

5 4 3 2 1 n/a

| O1.8 Chemical Use | Rating | Comments |
|---|---|---|
| 1 All chemicals used for cleaning, sanitizing and processing are listed in the CFIA's *Reference Listing of Accepted Construction, Packaging Materials and Non-Food Chemical Products.* | | |
| 2 All chemical containers are correctly labelled and stored in secure, locked areas where they do not pose a contamination risk to food, ingredients, packaging materials, or food contact surfaces. Incompatible chemicals are stored in separate areas. | | |
| 3 Material Safety Data Sheets (MSDS) are on file for all chemicals used in the facility. The sheets are easily accessible to all those who use any of these chemicals. | | |

| O1.9 Chemicals Used During Operations | Rating<br>5 4 3 2 1 n/a | Comments |
|---|---|---|
| 1 Chemicals are appropriate for their intended use and are used at correct concentrations. Care is taken during chemical use to ensure they don't contaminate adjoining processing, packaging, storage and shipping areas. Chemicals containers not in use are not present in processing, packaging, storage and shipping areas. | | |

| | | |
|---|---|---|
| **O1** Possible Points | **100** | |
| Actual Points | | |
| Percentage | | |

## O2 Shipping, Receiving, Handling and Storage

(5 - full compliance → 1 - non-compliance) n/a - not applicable

5 4 3 2 1 n/a

| O2.1 Conveyance Vehicles | Rating | Comments |
|---|---|---|
| 1 Incoming and outgoing conveyance vehicles are constructed of durable, easily cleanable materials, and are clean, odour-free, well maintained, contamination-free, and appropriate for their cargo. They are capable of maintaining proper product temperatures and preventing product contamination. | | |

5 4 3 2 1 n/a

| O2.2 Loading and Unloading Practices | Rating | Comments |
|---|---|---|
| 1 During loading and unloading, reasonable care is exercised to minimize damage to product, containers and the vehicle itself. To avoid potential cross-contamination, only clean, sound loading/unloading equipment and containers are used. | | |
| 2 Loads are assembled in such a way that they will retain their integrity during transit. | | |

5 4 3 2 1 n/a

| O2.3 Received Products | Rating | Comments |
|---|---|---|
| 1 Incoming food, ingredients, food/ingredient containers, packaging materials, and all other materials meet written predetermined specifications/standards for food safety and quality. Anything that does not meet these standards is rejected. | | |
| 2 Incoming materials are clearly identified. A vendor's lot code is present to permit traceability through the production system and back to the supplier. To facilitate First In, First Out (FIFO) inventory rotation, the date of manufacture, best before date or date of receipt is indicated. | | |

5 4 3 2 1 n/a

| **O2.4 Shipping Conditions** | **Rating** | **Comments** |
|---|---|---|
| 1 First In, First Out (FIFO) is practised. Products are staged in enclosed, temperature-controlled areas as close to shipping as possible. Perishable product vehicles are pre-cooled before loading. | | |
| 2 The shipping/receiving area is kept organized, tidy, clean, and free of debris and spoiled product to prevent cross-contamination. Spills are cleaned up immediately. | | |

5 4 3 2 1 n/a

| **O2.5 Returned and Defective Food Products** | **Rating** | **Comments** |
|---|---|---|
| 1 Returned food products are clearly identified and segregated in controlled areas until disposition (rework, repackage or disposal) has been determined. | | |
| 2 Rejected ingredients/products not immediately returned to the supplier are clearly marked and segregated in controlled areas until their return to the supplier. | | |

5 4 3 2 1 n/a

| **O2.6 Allergen Control** | **Rating** | **Comments** |
|---|---|---|
| 1 Ingredient suppliers are required to provide a complete list of ingredients including allergens. The presence of allergens is noted in all formulation and production records. | | |
| 2 Allergen-containing ingredients and products are properly labelled. They are stored in designated, controlled areas and have their own dedicated dispensing utensil and weigh container. | | |
| 3 Production scheduling and cleaning/sanitation procedures minimize the potential for allergen cross-contamination. Procedures for control of allergens are documented. | | |

5 4 3 2 1 n/a

| **O2.7 Packaging** | **Rating** | **Comments** |
|---|---|---|
| 1 Only new, food-grade, single-use packaging is used for microbiologically sensitive products. Reusable containers (e.g., bins, boxes, totes) are cleaned/sanitized between uses or have protective liners. | | |

| | | |
|---|---|---|
| 2 Stored and staged packaging materials are kept clean, dry and free from contamination. | | |
| 3 When glass materials are used in processing and storage areas, a written glass control program is in place to prevent contamination in the event of glass breakage. | | |

| O2.8 Storage Practices | 5 4 3 2 1 n/a<br>Rating | Comments |
|---|---|---|
| 1 All stored ingredients, materials and packaging are stored under appropriate temperature and humidity conditions. Materials are stored in a orderly manner in a way that permits adequate air flow and maintains the integrity of the product, ingredients or packaging. Products are not stored in the shipping and receiving areas. | | |
| 2 All storage areas are clean and free of debris and litter. Spills are cleaned up promptly. Stored ingredients, materials and packaging are clean, dry, intact and properly packaged to prevent contamination. | | |
| 3 Sufficient space is maintained along all walls, and materials are stored at an adequate height above the floor to permit proper cleaning and monitoring for pest activity. | | |
| 4 Temperatures of refrigerated products are monitored regularly and documented. Ingredients and finished products that require refrigeration are cooled rapidly and without delay to prevent microbial growth. | | |
| 5 Documented First In, First Out (FIFO) rotation practices are used for in-storage raw materials, finished products and packaging. Each is clearly labelled and dated to assist in FIFO implementation. | | |
| 6 Storage areas are separated from areas of other activity. | | |

5 4 3 2 1 n/a

| **O2.9 Chemical Storage** | **Rating** | **Comments** |
|---|---|---|
| [1] When not in use, chemicals are stored in separate, access-controlled areas, separate from food, ingredients, packaging supplies and food contact surfaces. | | |

5 4 3 2 1 n/a

| **O2.10 Waste Management** | **Rating** | **Comments** |
|---|---|---|
| [1] Interior solid waste containers are clearly identified, covered and not leaking. None are overflowing. Emptying is handled in a way that does not have the potential to contaminate goods, ingredients or packaging. Containers are cleaned after emptying so as not to be a source of contamination or act as an attractant to pests. | | |
| [2] Inedible waste containers are located close to the waste source but not in the way of processing activities. Waste is not decaying. Containers are not overflowing. Emptying is handled in a way that does not have the potential to contaminate goods, ingredients or packaging. Containers are cleaned after emptying so as not to be a source of contamination or act as an attractant to pests. | | |
| [3] Exterior waste containers are clearly identified, covered and do not leak. None are overflowing. The waste is not aged. All are located far enough away from the facility to discourage rodent travel. | | |
| [4] Wastewater is handled in a manner that will not create the potential for cross-contamination or attract pests. | | |

| | | |
|---|---|---|
| **O2** Possible Points | **130** | |
| Actual Points | | |
| Percentage | | |

## O3 Sanitation

(5 - full compliance → 1 - non-compliance) n/a - not applicable

| O3.1 Cleaning and Sanitation | Rating<br>5 4 3 2 1 n/a | Comments |
|---|---|---|
| 1 Sanitation Standard Operating Procedures (SSOPs) are in place to identify areas, equipment and utensils to be cleaned, the frequency of cleaning, the procedures and chemicals to be used, those responsible, the procedure to verify effectiveness and the records required. | | |
| 2 No cleaning practices are observed during operations that could potentially cause product contamination. For example, food and packaging are protected from contamination during cleanups. Water and air pressure is used in a way that does not create water droplets or aerosols that could potentially contaminate food, packaging or food contact surfaces. | | |
| 3 Cleanliness is evident throughout the facility in both processing and non-processing areas. Food contact surfaces are clean. There are no buildups or accumulations of food products or soil. Spills are cleaned up promptly. Utensils used during processing are cleaned and sanitized regularly. Floors are free of standing water. Hoses are neatly stored off the floor. Good housekeeping practices are observed. | | |
| 4 Cleaning/sanitizing containers, brushes, applicators, etc. are labelled or colour coded to prevent inadvertent use in unintended areas where there is potential for cross-contamination. | | |
| 5 There is evidence that materials/systems for checking sanitizer concentration levels are in place and used at appropriate intervals. | | |

| O3.2 Pre-Operational Assessment | Rating<br>5 4 3 2 1 n/a | Comments |
|---|---|---|
| 1 A designated individual(s) other than the individual(s) who performed the cleaning/sanitizing operations routinely performs a sanitation assessment before operations begin or resume. Operations do not start until sanitation standards meet SSOP requirements. | | |

| | | |
|---|---|---|
| **O3** Possible Points | 30 | |
| Actual Points | | |
| Percentage | | |

## O4 Equipment Maintenance

(5 - full compliance ➔ 1 - non-compliance) n/a - not applicable
5 4 3 2 1 n/a

| | O4.1 Preventative Maintenance and Calibration Monitoring | Rating | Comments |
|---|---|---|---|
| 1 | There is a preventative maintenance program in place for inspection, testing, lubrication, cleaning, adjusting, and parts replacement based on manufacturer's recommendations and operating conditions. | | |
| 2 | During maintenance and repair activities, steps are taken to reduce the risk of contamination of food, ingredients, packaging and food contact surfaces. This may include removing food from the area or covering it; monitoring time delays and temperature fluctuations that may contribute to contamination or decomposition; using tools dedicated to specific tasks; tool and parts reconciliation at the conclusion of the maintenance activity; wiping away excess lubricant; and cleaning/sanitizing before resumption of processing activities. Maintenance/repair workers, including temporaries and contractors, follow all personnel hygiene policies. | | |
| 3 | All repair/maintenance materials (including those used for temporary repairs) and lubricants are included in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products.* | | |
| 4 | Measuring and monitoring devices are routinely calibrated according to manufacturers' instructions and frequencies. Records of calibration activities are maintained. | | |

| | | |
|---|---|---|
| **O4** Possible Points | **20** | |
| Actual Points | | |
| Percentage | | |

## O5 Pest Control

(5 - full compliance → 1 - non-compliance) n/a - not applicable

5 4 3 2 1 n/a

| O5.1 Pest Control Monitoring | Rating | Comments |
|---|---|---|
| 1 There is no interior evidence of pest nesting activity, decomposed pests in the pest control devices, burrowing, excreta droppings, urine stains, footprints or gnawing. There are an adequate number of tamper-resistant pest control devices spaced at consistent intervals around the interior walls of the facility including on both sides of exterior doors. Toxic bait is not used inside the facility. There is proof that the pest control devices are monitored daily where there is evidence of pest activity or bi-weekly if no activity is evident. | | |
| 2 There are an adequate number of tamper-resistant pest control stations spaced at appropriate intervals around the building's exterior perimeter. Stations are secured in place and bait is anchored inside. They are situated so they do not contaminate product, packaging or equipment. Bait is adequate and fresh. There is proof that the pest control devices are monitored daily where there is evidence of rodent activity or bi-weekly if no activity is evident. | | |
| 3 There is no evidence of insects, flies or birds inside the facility. There is no evidence of insect, fly, bird or rodent contamination on or in any food products. | | |
| 4 There are an adequate number of insect control devices. They are positioned to maximize their efficiency but at an adequate distance away from exposed food, ingredients and food contact surfaces. There is proof that they are monitored and serviced on an appropriate schedule. | | |
| 5 All pest control devices are of sound construction, in good repair and functioning properly. | | |
| 6 All pesticides meet CFIA regulations. They are properly labelled and kept in locked, secured areas away from any food or processing areas. | | |

| | | |
|---|---|---|
| **O5** Possible Points | 30 | |
| Actual Points | | |
| Percentage | | |

## O6 Recall

(5 - full compliance → 1 - non-compliance) n/a - not applicable

| **O6.1 Product Code/Label Monitoring** | **Rating**<br>5 4 3 2 1 n/a | **Comments** |
|---|---|---|
| 1 All raw materials and finished products are identified with a permanent, legible code or lot number to enable traceability. Finished products can be traced back through the production process to raw materials and raw ingredients can be traced forward to the finished product. | | |
| 2 Product code information, distribution records, and customer and facility contact names are current and readily available. A mock recall is conducted at least once a year. | | |
| 3 Product labels are correct, not misleading or deceptive, and accurately describe ingredients, including allergens if they are present. A label reconciliation program in place. It includes regular review of product labels versus product being packaged, inspection of labels at receipt to ensure accuracy, and removal and destruction of obsolete labels. | | |

| | | |
|---|---|---|
| **O6** Possible Points | **15** | |
| Actual Points | | |
| Percentage | | |

## O7 Water Safety

(5 - full compliance → 1 - non-compliance) n/a - not applicable

5 4 3 2 1 n/a

| O7.1 Water Treatment Monitoring | Rating | Comments |
|---|---|---|
| 1 Water used for processing (washing, rinsing or conveying food) does not increase the level of contamination of the food. To ensure that water is potable, municipal water is laboratory tested at least twice a year. Water from other sources is tested at least once per month. Recycled water is routinely analyzed at a frequency appropriate to its degree of potential contamination. Water test records are retained. | | |
| 2 Water contact surfaces (e.g., dump tanks, wash tanks, flumes, hydro coolers) are cleaned/sanitized regularly enough to prevent ingredient/ product contamination. | | |
| 3 The level of disinfection of treated water used for washing, rinsing or conveying food is tested frequently to ensure that disinfectant levels remain effective but are not at levels that could contaminate food, ingredients, packaging or equipment. | | |
| 4 Water treatment and filtering equipment is appropriate for its application and well maintained. Metering devices are monitored and filters replaced before they become ineffective. | | |
| 5 A contingency plan is in place to deal with unsatisfactory water. | | |

5 4 3 2 1 n/a

| O7.2 Water Safety Monitoring | Rating | Comments |
|---|---|---|
| 1 Water safety monitoring and testing procedures are described in detail. Activities are overseen to ensure proper completion and any necessary followup activities. | | |

| | | |
|---|---|---|
| **O7** Possible Points | **30** | |
| Actual Points | | |
| Percentage | | |

## CONTROL PROGRAM ASSESSMENT

(5 - full compliance ➔ 1 - non-compliance) n/a - not applicable

5 4 3 2 1 n/a

| P1 Personnel Practices | Rating | Comments |
|---|---|---|
| 1 There is a written program in place describing food handler personal hygiene policy, procedure and controls. | | |
| 2 There is a written program in place describing food handler handwashing policy, procedure and controls. | | |
| 3 There is a written program in place describing food handler clothing, footwear, and headwear policy, procedure and controls. | | |
| 4 There is a written program in place describing food handler clothing, equipment, and utensils storage policy, procedure and controls. | | |
| 5 There is a written program in place describing food handler injury and wound policy, procedure and controls. | | |
| 6 There is a written program in place describing food handler illness policy, procedure and controls. | | |
| 7 There is a written program in place describing facility access and food handler and equipment traffic patterns that will minimize the potential for contamination of food, ingredients and packaging materials | | |
| 8 There is a written program in place describing chemical use and handling policy, procedure and controls. A master list of chemicals and relevant Material Safety Data Sheets are readily available. | | |
| 9 There is a written program in place describing chemical use policy, procedure and controls during operations. | | |
| 10 There is a written training program for each of the components listed above. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P1** Possible Points | **50** | |
| Actual Points | | |
| Percentage | | |

| P2 Shipping, Receiving and Storage | Rating<br>5 4 3 2 1 n/a | Comments |
|---|---|---|
| 1 There is a written program in place describing conveyance vehicle policy, procedure and controls. | | |
| 2 There is a written program in place describing loading and unloading policy, procedure and controls. | | |
| 3 There is a written program in place describing received product policy, procedure and controls. | | |
| 4 There is a written program in place describing shipping conditions policy, procedure and controls. | | |
| 5 There is a written program in place describing returned and defective food products policy, procedure and controls. | | |
| 6 There is a written program in place describing allergen policy, procedure and controls. | | |
| 7 There is a written program in place describing packaging policy, procedure and controls. | | |
| 8 There is a written program in place describing food, ingredient, and packaging storage policy, procedure and controls. | | |
| 9 There is a written program in place describing chemical storage policy, procedure and controls. | | |
| 10 There is a written program in place describing waste management policy, procedure and controls. | | |
| 11 There is a written training program for each of the components listed above. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P2** Possible Points | 55 | |
| Actual Points | | |
| Percentage | | |

| **WP3 Sanitation** | 5 4 3 2 1 n/a<br>**Rating** | **Comments** |
|---|---|---|
| 1 There is a written sanitation program in place. The sanitation program includes the building areas, equipment, and utensils to be cleaned and sanitized; the frequency of cleaning and sanitation for each building area, each piece of equipment, and each utensil; the procedures for cleaning and sanitizing; the chemicals to be used, their concentrations and the temperature of the cleaning or sanitizing solution; the job position responsible for each cleaning and/or sanitizing task; a procedure to verify that the cleaning and sanitizing has been effective; and the record keeping required. | | |
| 2 There is a written program in place describing pre-operational assessment policy, procedure and controls. | | |
| 3 There is a written sanitation training program.. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P3** Possible Points | **15** | |
| Actual Points | | |
| Percentage | | |

| **WP4 Equipment Maintenance** | 5 4 3 2 1 n/a<br>**Rating** | **Comments** |
|---|---|---|
| 1 There is a written program in place describing preventative maintenance and calibration monitoring policy, procedure and controls. The program includes personnel responsible; a description of the maintenance and/or calibration activity; the frequency of the maintenance/calibration activity; procedures to minimize the potential for cross-contamination, and the records to be completed. | | |
| 2 There is a written maintenance/calibration training program. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P4** Possible Points | **10** | |
| Actual Points | | |
| Percentage | | |

5 4 3 2 1 n/a

| **P5 Pest Control** | **Rating** | **Comments** |
|---|---|---|
| 1 There is a written program in place describing pest control policy, procedure and controls. The program should designate a pest control operator (either existing staff or an outside pest control company); outline the responsibilities and activities of the pest control operator (PCO); schedule pest control activities; specify the pesticides and mechanical devices to be used; include a map indicating the location and type of each internal and external pest control device (e.g. glue boards, insect light traps, tin cats, mechanical traps, etc.) each numbered for ease of tracking; and outline the documentation required to record the chemicals used, where these chemicals were used, any signs of pest activity, the corrective action taken in the event of pest activity, and the signature of the pest control operator as verification of his or her activity. | | |
| 2 If company staff carry out pest control activities, there is a written maintenance/calibration training program. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P5** Possible Points | 10 | |
| Actual Points | | |
| Percentage | | |

5 4 3 2 1 n/a

| **O6 Recall** | **Rating** | **Comments** |
|---|---|---|
| [1] There is a written program in place describing recall policy, procedure and controls. The program should include the person(s) responsible for coordinating and implementing a recall; procedures to identify, locate and control the implicated product; measures to investigate violation causes and steps to control them; and procedures to test effectiveness of the recall at predetermined intervals. | | |
| [2] There is a written recall training program. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P6** Possible Points | **10** | |
| Actual Points | | |
| Percentage | | |

5 4 3 2 1 n/a

| **O7 Water Safety** | **Rating** | **Comments** |
|---|---|---|
| [1] There is a written program in place describing water treatment policy, procedure and controls. The program should include the water treatment activity to be performed (e.g., UV treatment of well water, wash water chlorination, filtering/treatment of recycled wash water or flume water); the personnel responsible for each of the treatment activities; the chemicals/equipment required for each treatment; explicit directions as to how to use the required equipment, including filter, screen, etc. cleaning and maintenance. For chemicals, explicit directions as to proper handling of the chemicals (for personal safety and to prevent or minimize contamination), including the concentration to be used; the criteria/schedule for water treatment activities; and the documentation required. | | |
| [2] There is a written program in place describing water monitoring policy, procedure and controls. The program should include a list of the water samples to be collected and the schedule for collecting them; a detailed description of the water sample collection and sample submission procedures; the personnel responsible for each task; documentation requirements for each sample; and the actions to be taken when the water analysis does not meet predetermined criteria. | | |

|  |  |  |
|---|---|---|
| [3] There is a written water treatment/monitoring training program. The written programs may be used as a training aid. |  |  |

|  |  |  |
|---|---|---|
| **P7** Possible Points | **15** |  |
| Actual Points |  |  |
| Percentage |  |  |

## Summary

| Control Program Element | Percent | Comments |
|---|---|---|
| 1 Personnel Practices |  |  |
| 2 Shipping, Receiving, Storage |  |  |
| 3 Sanitation |  |  |
| 4 Equipment Maintenance |  |  |
| 5 Pest Control |  |  |
| 6 Recall |  |  |
| 7 Water Safety |  |  |

# GLOSSARY[1]

**acid**—a substance containing a high concentration of hydrogen ions, which creates a pH value less than 7.0

**activated carbon**—charcoal that has been burned in the absence of oxygen to increase the adsorptive surface area of the carbon

**active modification**—replacement of air within a package with an atmosphere high in carbon dioxide or nitrogen and low in oxygen by removal of oxygen and replacement with carbon dioxide or nitrogen

**adsorption**—adhesion of a substance to the *surface* of a solid or liquid

**aerosols**—suspended droplets of liquid containing microorganisms; often caused by splashing water against contaminated surfaces in a food processing environment

**alkaline**—a substance with a relatively low concentration of hydrogen ions, which creates a pH value greater than 7.0

**ATP bioluminescence**—adenosine triphosphate (ATP) is an energy molecule found in all organic substances. When luciferin/luciferase enzyme (found in fireflies) reacts with ATP, light is released. Measuring light intensity (ATP bioluminescence) with a luminometer provides an indication of the level of biological residue on a surface.

**bacteria**—microscopic, single-celled organisms found in soil, air, water, and the intestinal tract and mucous membranes of animals and humans; these cells multiply by dividing in two (binary fission)

**biofilm**—an invisible layer of organic secretions, attached to surfaces that appear to be clean and sanitary, that harbours living bacteria cells; can be difficult to remove during cleaning sanitation procedures

**Canadian Food Inspection Agency (CIFA)**—the federal agency responsible for the enforcement of the policies and standards under the Agriculture and Agri-Food Administrative Monetary Penalties Act, Canada Agricultural Products Act, Canadian Food Inspection Agency Act, Feeds Act, Fertilizers Act, Fish Inspection Act, Health of Animals Act, Meat Inspection Act, Plant Breeders' Rights Act, Plant Protection Act, Seeds Act, and the Consumer Packaging and Labelling Act, and the enforcement of the Food and Drugs Act as they relate to food; focuses on federally registered establishments that engage in interprovincial and export trade.

---

[1] These definitions are specific to the context of this Guidebook.

**Canadian General Standards Board (CGSB)**—an agency of the Government of Canada, it offers independent certification services. It is the auditing body for the *GMP Advantage*, *HACCP Advantage* and *HACCP Advantage Plus+* programs.

**Canadian Horticultural Council (CHC)**—a voluntary, not-for-profit, national association representing producers and packers of over 120 horticulture crops including fruit, vegetables, flowers and ornamental plants

**Center for Science in the Public Interest (CSPI)**—a U.S. consumer advocacy group that focuses on food and nutrition issues

**chelating agent**—an organic compound that keeps metals in water from combining; also known as sequestering agents, chelating agents prevent metal buildup that causes staining

**chemical agent**—a compound that increases the effectiveness of water in removing soil and other foreign materials from surfaces

**cleaning**—the process of removing surface dirt, debris and associated bacteria from a surface by washing with water and detergent

**clean-in-place (CIP)**—a continuous system whereby cleaning or sanitizing agents are recirculated through intact machinery

**clean-out-of-place (COP)**—a cleaning and sanitizing system used for equipment that can be disassembled and placed in a soak or circulating tank

**Codex Alimentarius Commission**—an international organization created in 1963 by the Food and Agriculture Organization and the World Health Organization to protect the health of consumers, ensure fair food trade practices, and promote co-ordination of all food standards work undertaken by international governmental and non-governmental organizations

**condensate**—water that has been produced by the cooling of steam or water vapour

**critical control points (CCPs)**—a point, step or procedure in a food manufacturing process at which a control measure can be applied to eliminate, prevent, or reduce a food safety hazard to an acceptable level

**cross-contamination**—the physical movement, or transfer, of harmful microorganisms or trace allergen products from one person, object, food or place to another

**effluent**—liquid or waterborne waste of industrial or commercial origin that has been treated

**enteric pathogens**—illness or disease-causing microorganisms found in the intestinal tract of humans

**fat-oil-grease buildup (FOG)**—the accumulation of grease in sumps, drains and traps

**Food and Agriculture Organization (FAO)**—an agency of the United Nations serving both developed and developing countries, it helps developing countries and countries in transition modernize and improve agriculture, forestry and fisheries practices and ensure good nutrition for all

**Food Safety Enhancement Program (FSEP)**—the Canadian Food Inspection Agency's (CFIA) program to encourage and support the development, implementation and maintenance of Hazard Analysis Critical Control Point (HACCP) systems in all federally registered establishments of the meat, dairy, honey, maple syrup, processed fruit and vegetable, shell egg, processed egg and poultry hatchery sectors

**food spoilage microorganisms**—fungi and bacteria that impair the flavour, aroma and appearance of a food; they include *Pseudomonas* spp., lactic acid bacteria such as *Leuconostoc mesenteroides* and *Lactobacillus* spp., *Erwinia herbicola, Flavobacterium, Xanthomonas, Enterobacter agglomerans*, yeasts and moulds; the type and magnitude of microbial growth can vary greatly for different produce items and storage conditions

**fungi**—parasitic organisms that lack chlorophyll, they grow on living or dead organisms; yeast, moulds, rusts, mildews, smuts and mushrooms are types of fungi

**Good Agricultural Practices (GAPs)**—systematic approaches to prevent or control contamination of crops during growing, harvesting and transporting. Key areas of concern include prior land use, adjacent land use, water quality and use practices, soil fertility management, wildlife, pest and vermin control, worker hygiene and sanitary facilities, and harvesting and cooling practices.

**Good Manufacturing Practices (GMPs)**—the basic, universal conditions that control hazards related to personnel and the food manufacturing environment; GMPs create conditions favourable for the production of safe food

**Granular Activated Carbon (GAC)**—a relatively loose bed of activated carbon granules used for liquid or gas filtration. Because the carbon grains are loosely held, open paths may be created, shortening contact time and making filtration less effective.

**HACCP (Hazard Analysis Critical Control Points)**—an internationally recognized, science-based, food safety program designed to reduce, prevent, or eliminate potential biological, chemical, and food safety hazards directly related to the food being processed or the manufacturing process

**heterotrophic**—organisms capable of deriving energy for life processes only from the decomposition of organic compounds, and incapable of using inorganic compounds as sole sources of energy or for organic synthesis

**heterotrophic plate count (HPC)**—procedure for estimating the total number of live heterotrophic bacteria in a sample. Used as an indicator of poor general biological quality, this test detects a broad group of bacteria including non-pathogens, pathogens and opportunistic pathogens, but it does not pretend to report all of the bacteria in the sample.

**inorganic**—derived from mineral sources; examples include sand, salt, iron and calcium salts

**luminometer**—a sensitive photometer used for measuring very low light levels

**Material Safety Data Sheets (MSDS)**—fact sheets designed to reflect the hazards of working with and/or storing a particular chemical, they provide workers with information such as physical data, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment and spill/leak procedures.

**microbe**—another word for a microorganism

**microorganisms**—living entities that are too small to be visible to the naked eye; they include bacteria, viruses, protozoa, and fungi such as yeasts and moulds

**microbiological**—an adjective used to express an attribute relating to microorganisms e.g., the microbiological quality of water

**modified atmosphere packaging (MAP)**—packaging that allows the exchange of gases and moisture to produce the optimal storage environment to slow product deterioration and to maximize protection from food safety contaminants

**moulds**—multicellular organisms that form fuzzy or powdery patches (mycelium) on organic matter such as fruits and vegetables; moulds are fungi

**non-potable water**—water that is unsafe to drink because it contains pollutants, contaminants, minerals or disease-causing microorganisms

**organic**—carbon-containing compounds obtained from plant or animal sources

**parasites**—organisms that obtain nourishment from a living plant or animal in order to grow and reproduce, usually to the detriment of the host

**passive modification**—replacement of air within a package with an atmosphere high in carbon dioxide or nitrogen and low in oxygen by oxygen depletion through normal respiration

**pathogen**—a microorganism that is capable of causing illness or disease when it enters the human body

**pathogenic microorganisms**—illness- or disease-causing bacteria, protozoa, viruses or fungi

**personal protective equipment (PPE)**—equipment or clothing worn to prevent injury or illness from occurring while handling hazardous materials

**pest control operator (PCO)**—person or company that is licensed to apply pesticides as a business

**pH**—the acidity or alkalinity of a liquid measured by the concentration of free hydrogen ions and expressed on a logarithmic scale. If the pH is below 7.0, the solution is acidic (the lower the number, the greater the degree of acidity); if it is above 7.0, the solution is alkaline (the higher the number, the greater the level of alkalinity); a pH of 7.0 is neutral (neither acid nor alkaline).

**physical agent**—includes heat, cold, noise, radiation, electricity, etc. that can occur naturally or can be produced e.g., heat is a physical agent that be result from weather or be created to kill microorganisms

**potable water**—water that is safe for drinking

**reverse osmosis (RO)**—a process in which water is forced under pressure through a synthetic semi-permeable membrane under pressure to remove unwanted substances

**Sanitation Standard Operating Procedure (SSOP)**—written step-by-step procedures that describe in detail how cleaning and sanitation procedures should be done to comply with Good Manufacturing Practices requirements related to cleaning and sanitation

**sanitizing**—use of heat or chemicals to reduce the number of microorganisms on a clean surface to safe levels

**schmutzdecke**—the complex biological layer of bacteria, fungi and protozoa formed on the surface of slow sand filter beds that provides effective purification in potable water treatment

**senescence**—the process of deterioration in quality in stored, respiring fruits and vegetables after harvesting

**sewage**—waste of domestic origin (human body waste, and waste from showers, tubs, sinks and laundry)

**Solid Block Activated Carbon (SBAC)**—created by compressing very fine activated charcoal with a binding medium and fusing them into a solid block. The intricate maze created ensures complete contact with impurities and their effective removal.

**Standard Operating Procedures (SOPs)**—written step-by-step procedures that describe in detail how a procedure should be done to comply with Good Manufacturing Practices requirements, except those related to cleaning and sanitation

**surfactant**—an agent that reduces the surface tension of a liquid (usually water) to permit the penetration of cleaning compounds by increasing the emulsifying, foaming, dispersing, spreading and wetting properties of a product; reduces the surface tension between two liquids

**Total Plate Count (TPC)**—another term for Heterotrophic Plate Count (HPC) test

**trihalomethanes (THMs)**—A group of low-molecular-weight, halogenated hydrocarbons, derivatives of methane ($CH_4$), in which three halogen atoms (chlorine, bromine or iodine) are substituted for three of the hydrogen atoms. The group includes suspect human carcinogens. Small amounts of THMs have been detected in raw water collected from surface sources used as a public water supply, and concentrations have been shown to be increased during the chlorination phase of the water purification process.

**turbidity**—cloudiness in water caused by suspension of clay, silt, other finely divided organic and inorganic matter, and microscopic organisms

**U.S. Centers for Disease Control and Prevention (CDC)**—as one of the 13 major operating components of the U.S. Department of Health and Human Services (HHS), it conducts research and investigations to prevent and control infectious and chronic diseases, injuries, workplace hazards, disabilities and environmental health threats.

**United States Food and Drug Administration (USFDA)**—federal regulatory agency for food, drugs, medical devices, biologics, animal feed and drugs, cosmetics, and radiation-emitting products in the United States

**virus**—an ultramicroscopic piece of nucleic acid (DNA or RNA) wrapped in a thin coat of protein that can be seen only with an electron microscope; very infectious and often pathogenic, a virus reproduces by inserting itself into a living host cell and altering the function of that cell

**wastewater**—water that has been adversely affected in quality by human, industrial, agricultural or commercial processes

**Workplace Hazardous Materials Information System (WHMIS)**—a comprehensive national system for safe management of hazardous chemicals that is legislated by both the federal and provincial governments. Under WHMIS legislation, all suppliers (manufacturers, importers, packagers and processors) are required to label and prepare Material Safety Data Sheets (MSDSs) for products they make, import, package or process that meet the hazard criteria set out in the Controlled Product Regulations under the federal Hazardous Products Act.

**World Health Organization (WHO)**—specialized agency of the United Nations that acts as a co-ordinating authority on international public health; 192 countries are members

**yeast**—a unicellular fungus that grows spherical or oval single cells rather than mycelium; can be either beneficial or detrimental in food processing

# NOTES

**OMAFRA Contacts**[1]

John Henderson
Risk Management Specialist
Ontario Ministry of Agriculture, Food and Rural Affairs
95 Dundas Street
Brighton, ON
K0K 1H0
(613) 475-5175
john.henderson@omafra.gov.on.ca

Bengt Schumacher
Risk Management Specialist
Ontario Ministry of Agriculture, Food and Rural Affairs
2284 Nursery Road
Midhurst, ON
L0L 1X0
(705) 725-7295
bengt.schumacher@omafra.gov.on.ca

Peter VanWeerden
Risk Management Specialist
Ontario Ministry of Agriculture, Food and Rural Affairs
4890 Victoria Avenue S.
Vineland, ON
L0R 2E0
(905) 562-1671
peter.vanweerden@omafra.gov.on.ca

Sarah Holmes
Risk Management Associate
Ontario Ministry of Agriculture, Food and Rural Affairs
1 Stone Road West, 5th Floor NW
Guelph, ON
N1G 4Y2
(519) 826-5996
sarah.holmes@omafra.gov.on.ca

Paul Bailey
Technical Advisor, Food Safety and Quality
Ontario Ministry of Agriculture, Food and Rural Affairs
1 Stone Road West, 5th Floor NW
Guelph, ON
N1G 4Y2
(519) 826-4377
paul.bailey @omafra.gov.on.ca

**General Inquiries**

Kathy MacDonald
Ontario Ministry of Agriculture, Food and Rural Affairs
1 Stone Road West, 5th Floor NW
Guelph, ON
N1G 4Y2
1-888-466-2372 ext. 64395
(519) 826-4395
food @omafra.gov.on.ca

---

[1] February 22, 2006